

A. I should say it was about 15 feet in diameter.

3178 Q. Where is that?

A. Well, there are two or three of them I can recall particularly the Green Avenue relief sewer.

Q. That is in Brooklyn?

A. That is in Brooklyn.

Q. And another one?

A. The outlet sewer for the Flatbush and Fort Hamilton Districts, which discharges into New York Bay at the foot of 65th Street.

Q. Any other, that is in Brooklyn I suppose?

A. These are all Brooklyn, all the large sewers.

Q. Any other?

A. There was a large sewer that was done under my supervisory charge in Queens at the foot of Webster Avenue, not quite as large but approximately.

Q. How many inhabitants does the Green Avenue sewer serve?

A. That is more especially a storm relief sewer. It is not supposed to take concentrated domestic sewage. As a matter of fact it does take it, but it was not intended to.

Q. The other, the Hamilton Avenue one?

A. The 65th Street sewer, which I think was the next one mentioned is built for a very large population.

Q. How large?

A. Well, the territory is 5,000 acres approximately, and I suppose there will be eventually 50 people to the acre. That would be 250,000 people, but it will be a long time.

Q. How many people are there now?

A. It would be difficult for me to say, without referring to statistics. I should judge about 50,000 people.

Q. These sewers discharge at low tide?

A. Just below low tide.

Q. How much below?

A. Probably about 4 feet.

Q. When were they built?

A. The 65th Street sewer was built, as I recall it, was completed about 1901.

3179 Q. The Green Avenue sewer when was that built?

A. The Green Avenue sewer was completed about 1894.

Q. How near the shore line do these sewers discharge?

A. The 65th Street sewer was carried out on a pier, a concrete pier to the pierhead line.

Q. The Green Avenue sewer?

A. The Green Avenue sewer discharged at the head of Gowanus Canal. That sewer has been diverted now and discharges into the East River at about the foot of Raymond Street.

Q. At any depth?

A. I am not familiar with that within the last two or three years.

Q. From the dilution standpoint, could the sewers be discharged much worse than they are?

A. No. The concentrated outlets are very much more objection-

able than a small number of outlets carrying the same amount of sewage, but discharged at a large number of places.

Q. What is the character of the sewage discharged into Boston Harbor; is it storm water, combined sewage?

A. Mostly domestic sewage with some manufacturing wastes. The outfall sewers are not supposed to take any large amount of rain water, for the reason it is almost always pumped and overflows into the various streams that they cross within the city limits, which relieves the city sewers from the storm water before the sewage is delivered at the pumping station at Moon Island.

Q. So that the sewage as it is discharged into Boston Harbor is pretty well concentrated sewage?

A. Typical domestic sewage from a large city.

Q. And that is about as objectionable as you can conceive of, is it not?

A. There is not much difference in sewage from that standpoint.

Q. Is not sewage diluted with storm water less objectionable than that which is not?

A. Oh, yes, if you refer to that point.

3180 Q. Well, do you know whether or not the proposed Passaic Valley sewer is to serve storm water or not?

A. I believe it is to take a certain amount of storm water for a certain period of time.

Q. Well, is it not designed to take all the storm water of the City of Newark?

A. No, I do not so understand it.

Q. Where do you get your information from?

A. My understanding is that the capacity of the Passaic Valley sewer is limited to the amount of domestic wastes which will be discharged from the district by a certain time, 1940 or 1950, and that period to that time it is estimated there will be a surplus capacity which may be used so far as it will go to take care of certain storm water from the City of Newark, thereby giving the City of Newark an opportunity to build water outlets to take care of the combined sewers which they now have.

Q. You know the whole system at Newark at present is combined, do you not?

A. I believe it is, yes.

Q. And it is hoped to put this trunk sewer in operation at the expiration of three or four years?

A. That is my impression of the proposal.

Q. Now the Moon Island outlet I think is near the surface?

A. Right near the surface.

Q. Horizontal or vertical?

A. Horizontal.

Q. The Deer Island outlet, how much below the surface is that?

A. It is about 9 or 10 feet below the surface, was at the time I was there.

Q. What is the character, horizontal or vertical?

A. I was told it was horizontal. I did not see it.

Q. Who told you it was horizontal?

A. The engineer who was there, the engineer at the pumping station, I forget his name.

Q. You did not investigate?

A. I could not get down there, no.

3181 Q. You know as a matter of fact that it is a vertical discharge?

A. Do I know, no,—I understand it is horizontal. It may have a bend at the end of it, but I could not ascertain that. I do not think that it is of any importance.

Q. You don't?

A. No.

Q. Therefore you did not investigate it with any degree of care?

A. No, I did not.

Q. You do not consider it of any importance?

A. No, I do not.

Q. And the Nut Island outlets, what are they, horizontal or vertical?

A. I was told by Mr. Smith, the engineer in charge of that station that the outlets there at present are up vertically at the ends.

Q. What is the name of the gentleman who gave you this information?

A. His name is Smith, Frederick D. Smith.

Q. Would it surprise you to find that as a matter of fact the Nut Island discharge is horizontal and that the Deer Island is vertical?

A. Would it?

Q. Yes.

A. I do not know as it would surprise me very much. I do not consider it is essential to the success of the plan one way or the other.

Q. Have you got any memoranda taken at the time which shows what Mr. Smith did tell you?

A. Yes, and I have the note here with me.

Q. Did you happen to see Mr. William H. Brown in your visit to Boston on that occasion?

A. Yes, I called on Mr. Brown.

Q. Did he go with you?

A. No, he did not go with me.

Q. How did you happen to reach the conclusion that you would need a guide to the Nut Island outlet?

3182 A. For the reason that the outlet sewers are very deep there, and are more than a mile from the shore and the engineer, the captain of the steamer said that he—I think he said that he had never been in that part of the harbor, it was off the beaten track of the steamers and that was why I thought it would be necessary to have somebody in charge of the operation of the plant to go with me.

Q. Don't you know that a party from the New York Metropolitan Sewerage Commission attempted to find the Nut Island outlet and were unsuccessful?

A. I never heard that.

Q. Do you not know that Mr. Brown went with them and attempted to point it out and was not able to?

A. I never heard that.

Q. And they had to return and get a chart with a man who could indicate from actual observations, astronomical observations where the outlet was?

A. I never heard that.

Q. Would you be surprised to hear that?

A. Yes.

Q. That was not the reason why you took a guide?

A. No, I never heard of that.

Q. Well, what is the population as you understand it, that is served by the Nut Island outlet?

A. About 350,000 people.

Q. Now, just what did you observe at the outlet at Nut Island?

A. I observed two boiling streams as near as I can express it, of discolored water appearing at the surface. The tide at that time was almost slack water and the sleek which accompanied this boiling stream spread out in relatively small areas around the two outlet pipes. As I stated before the amount of sleek and the amount of odor was not as great as I had observed previously at Deer Island, but still it was very noticeable, and if I had seen it before I saw the Deer Island plant, it might have impressed me more.

3183 Q. How much in area did it cover?

A. I should say that the area covered at each outlet was in the neighborhood of 10 acres.

Q. When *did* you say it is covered, what do you mean by that?

A. I mean that the discolored area which was plainly noticeable from the upper deck of this boat covered about 10 acres. If I could have gone up higher it might have been bigger.

Q. How did you actually locate these 10 acres?

A. You mean estimate the size?

Q. How did you locate them?

A. They were in the vicinity of this boiling mass of water which I spoke of coming up above the outfall.

Q. How much below the surface is the outfall?

A. 30 feet below high tide.

Q. You saw a boiling stream?

A. Yes, it was a boiling mass.

Q. Where were the gulls?

A. The gulls were at varying heights from a few feet to 30 or 40 feet. Every once in a while they would swoop down, and apparently pick up something.

Q. Then the way you located the outlets was by the gulls?

A. Yes.

Q. Now, what is the character of the discharge from the Passaic Valley Sewerage project, which in your judgment is the one which is to produce the nuisance that you have testified will be produced in New York Harbor?

A. In making that statement I took into consideration the population and the amount of sewage to be delivered at the outlet, and

the amount of treatment which I understand the sewage is likely to receive.

Q. What is the amount of treatment which you understand the sewage is to receive?

A. My understanding is that the sewage is to be conveyed to a pumping station on the Newark meadows near Newark Bay. Then before it enters the pumping station from the trunk sewer, it is to pass through some relatively coarse screens. After that it
3184 is to pass through a grit chamber. From the grit chamber it is to pass through some finer screens and which will go to a series of sedimentation basins, with a rest of from an hour to an hour and a half, depending upon the period of the day. After that, after receiving this treatment of sedimentation, the sewage is to be discharged by pumps to New York Bay near Robbins Reef.

Q. After the effluent thus produced, will it or will it not when discharged into New York Bay have suspended particles visible to the naked eye?

A. It will.

Q. And will it produce an odor at the point of discharge?

A. It will.

Q. Will there be grease and color perceptible at the point of discharge coming from the sewage?

A. I shall expect to find them there.

Q. Will it perceptibly decrease the oxygen content of the water of New York Bay in your opinion?

A. It will increase the present tendency of loss of oxygen in the Bay.

Q. That is practically the same thing as my question is it not? And will it be injurious to health the effluent I mean?

A. It will increase any condition that may now be injurious to health in the Bay.

Q. Well, why do you say you understand that is the character of effluent that is to be discharged from this sewer confin/ it entirely to the processes that are contained in the stipulation?

A. I have never heard any other process was contemplated.

Q. I know, but you know the stipulation guarantees that certain results will be produced, don't you?

(Witness examines stipulation.)

Q. Look at the second paragraph there?

A. Yes, I see that this says that they will be produced.

3185 Q. You think that the processes as defined will not produce that effluent?

A. I should say not.

Q. Is it feasible to produce an effluent which will embody or entail the results that are guaranteed in that stipulation, being Complainants' Exhibit No. 135?

A. I should say it would be possible.

Q. Why do you say the discharge contemplated is not the discharge as guaranteed by the State of New Jersey, and Passaic Valley Sewerage Commissioners in this stipulation?

A. I should say that the plant described in the stipulation could not possibly secure those results.

Q. I understand that Mr. Provost, but you say that the effluent that is contemplated will not produce the results and I want to know why you say that is not contemplated when the stipulation guarantees that it shall be produced. How do you know that it is not contemplated?

A. I have no definite knowledge of what is contemplated except what is in the stipulation.

Q. You see that in that stipulation the results are guaranteed, do you not, you see that, don't you?

A. I see the stipulation calls for results.

Q. Guarantees, the parties named the Passaic Valley Sewerage Commissioners and the State of New Jersey guarantee certain results you see that?

A. That is provided it could be shown that these results were not obtained.

Q. Well, where do you see that? Will you point out where any such provision appears?

A. This stipulation must be enforced I suppose.

Q. That is not the question. You put in the proviso there. Now will you point out the proviso?

A. I must assume that if this plant is built as contemplated in this stipulation and if after that there should be any doubt
3186 as to whether they did comply or not, there would be serious doubt in my mind as to whether it could be shown that there was compliance or non-compliance.

Q. Yes, I understand that, but when you testified as I understand you to the effluent or the discharge as contemplated, that it would create a nuisance, I want to understand where you get your foundation for that understanding as to what is contemplated?

A. I am assuming that the plant will be built as described in this stipulation.

Q. You are assuming that, that is quite right. Now, what else are you assuming. Do you assume that the plant will produce the guaranteed results or do you assume that it will not?

A. I assume that that plant will not produce those results.

Q. And for that reason you assume that the State of New Jersey and the Passaic Valley Sewerage Commissioners do not contemplate carrying out this stipulation, do you?

A. I should not say that, no.

Q. Well, why not? What are they going to do, carry it out?

A. I should say it might be difficult for anybody to say whether they were carried out.

Q. That has nothing to do with what is contemplated. I want to know where you get the conclusion that they contemplate violating the stipulation?

A. My interpretation of that stipulation, without going into the legal side, would be that a plant will be built such as described there, and if it is found afterwards that it did not comply, then the other clauses of the stipulation would apply, if they were practicable.

Q. They are practicable, are they not?

A. If the necessity for them is obvious.

Q. I am not saying anything about the necessity. I am asking you if they are practicable in your judgment?

3187 A. I think the plant could be built that would comply.

Q. And do you know of any way of disposing of the Passaic Valley sewage, so that there will not be a nuisance to the people of Newark Bay or the Passaic River, or as you have testified in New York Harbor?

A. Do you know of any way?

Q. Yes.

A. I think if I were employed to find a way, I might find it.

Q. Do you know at this present moment, does any way suggest itself to you other than producing an effluent such as is specified there?

A. There are several ways of doing it. The steps described here are merely the beginning of sewage purification.

Q. You would add something to them?

A. It would be necessary to add to them.

Q. Then that would give you an effluent that would produce these results?

A. I think they could be secured.

Q. Why do you say that the Passaic Valley Sewerage Commissioners and the State of New Jersey are not going to produce those results, do not contemplate producing them?

A. I do not think that I testified to that.

Q. You have testified as to the contemplated discharge which you said would produce a nuisance?

A. As I understand the plans to be.

Mr. Riker: That is all, Mr. Provost.

Redirect examination by Mr. O'Sullivan:

Q. How about the cost of a plant capable of securing such an effluent. Would you consider the cost prohibitive or moderate?

Mr. Riker: There are some degrees between prohibitive and moderate.

Mr. O'Sullivan: I am giving him latitude enough. There the stipulations are ambiguous.

3188 A. I should consider the cost very extensively burdensome to the territory.

Q. Mr. Provost, you were asked as to whether certain of these outfalls, whether at the discharging point the discharge pipe was horizontal or vertical. Does it make any particular difference as to whether they are vertical or horizontal?

A. Not in my opinion.

Q. Will the sewage still rise to the surface?

A. It will rise to the surface irrespective of that.

Q. No matter how it is discharged?

A. Irrespective of the shape or elevation of the discharge.

Q. You located some of these—or rather their location was evi-

dent you stated from the boiling up of discolored water. Will you describe in some other way what you mean by the boiling up?

A. This action which I referred to was most noticeable at the Deer Island outfall. A small boat there would have been severely rocked by the bouyancy of this sewage as it came up through the salt water in which it is discharged. As I recall it that crater of water was probably 20 feet in diameter, and it was I should judge 18 inches high above the surrounding water. It came in a sort of series of fountains. There was no spray but there was a movement, a distinct aggressive movement to the water above this outfall. At the Nut Island outfall, the motion of the water was much less marked, but it still was marked. It is very plain, but the area, both the area and the height of the disturbance was materially less than at the Deer Island outlet. Of course the amount of sewage is very much less also, only about one third.

Q. Was the sewage area immediately adjacent to the outfall in every case elevated above the surface of the water?

A. Yes, in every case. At Moon Island the material enters the tide from a superior elevation. It rushes down and feeds
3189 itself out on top of the surface of the harbor, and was noticeable in a distinct moving stream on account of the impetus which it received coming from these elevated storage tanks.

Q. A moving stream in what direction?

A. A stream moving seaward.

Q. Did you need a chart or sextant or azimuth compass to locate that seething mass of sewage as it came up?

A. No, nothing was necessary besides the general knowledge of the locality there and a small map of the harbor which I had with me to identify the islands and other geographical points. The sewage from the Moon Island discharge spread out in the shape of a fan, after it left the outfall, and the fan divided as it approached Long Island, which runs about north east and south west, as I recall it, quite a long island, and this fan divided into two fingers, one of which ran to the north of Moon Island, the other running on to the south side, the southerly one ran down towards the Nut Island outlet and the northerly one ran down towards the Deer Island outlet.

Q. Do you describe these fingers of sewage that you have just now testified to as sewage fields or dispersion areas or any such term?

A. Well, they might be called sewage fields and dispersion areas.

Q. Did you notice in addition to that any sleek fields as the result of this boiling mass of sewage that came up as you have described?

A. The sleek field carries considerably further than the discolored water surface. The grease seemed to spread out into a very thin film, which went further than the discoloration in all cases.

Q. Were you appraised of the vicinage of these outfalls by the odors in addition to the elevation of this seething mass of sewage?

A. Yes, the outfall at Deer Island, where the discharge is continuous, was very noticeable. One would notice that easily at

night, passing in a boat. The odors at the Nut Island discharge were much less noticeable, and in fact I do not think that at a quarter of a mile away on the leeward side, there will be anything noticeable at all. In the direction in which the wind came, those odors would be noticeable at long distances. At the Moon Island outlet the odor there was extremely putrid and sickening, and that could be detected at a long distance. The sewage field was accompanied by strong odors for a mile and a half from Moon Island outlet.

Q. You mentioned something about gulls, Mr. Provost. Are they indicative of sewage areas and sewage fields insofar as they are ordinarily in the neighborhood of such areas?

A. Well, the gull is a scavenger and feeds on decomposing matter, and they are usually found around floating masses of sewage.

Q. In what condition would you expect the sewage as discharged from the Passaic Valley Trunk Sewer outfall to be as to its age?

A. I should expect the sewage from the Passaic Valley trunk sewer by the time that it reaches Robbins Reef, to be in an extremely putrid condition.

Q. May sewage contain sufficient organic matter in solution and yet be devoid of suspended particles so as to be highly putrescible?

A. It may.

Q. Is colloidal matter putrescible?

A. Part of it is.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. You do not agree with Mr. Jackson as to the condition of the Passaic Valley sewage when it will be discharged at Robbins Reef. You heard him testify that it would be fresh, did you not, it would not be septic, at any rate?

A. I think it would be quite putrid.

Q. You do not agree with him?

A. Apparently not, if he thinks it will be fresh.

Q. You heard him testify?

A. Part of his testimony.

3191 Q. You heard him say that it would not be septic, did you not?

A. That was my understanding that he so testified.

Q. Well, you say the purification of the Passaic Valley sewage, so as to produce the guaranteed results will be burdensome. Just what do you mean by burdensome?

A. I mean that it would involve a tax upon the people benefited which would probably be very difficult for them to pay.

Q. Convert it into dollars and cents please. How much money do you think it would be necessary to expend in the plant in the first place to produce the results?

A. Well, I should hesitate to give any estimates of the cost of that without considerable study. It is my opinion without such study, I should say it would cost a great many millions of dollars.

Q. Do you know whether the sewer as now protected by the

Passaic Valley Sewerage Commissioners is burdensome or not upon the territory?

A. I should say from what I have heard of the estimate it probably would be somewhat burdensome.

Q. And an increase in the processes or in the cost of the plant, or in the cost of the treatment of the sewage will make it more burdensome?

A. Make it more burdensome.

Mr. Riker: That is all.

Mr. O'Sullivan: That is all, Mr. Provost.

Adjourned to September 17, 1912, at 10:30 A. M.

3192 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
 against
 STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

CORPORATION COUNSEL'S OFFICE,
 NEW YORK CITY, Sept. 17, 1912—10:30 o'clock a. m.

Before James D. Maher, Esq., Commissioner.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

HERBERT D. PEASE, a witness called on behalf of the Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name?

A. Herbert A. Pease.

Q. And what is your occupation?

A. Bacteriologist and sanitary expert.

Q. Where did you graduate?

A. I graduated in medicine from the University of Toronto in 1893, was a post-graduate student and Fellow in Pathology in the Johns-Hopkins University and hospital from 1893-1895. I
 3193 was first assistant bacteriologist of the Bureau of Pathology, Philadelphia from 1895 to 1898. I was Pathologist of the New York State pathological laboratory, University of Buffalo, from 1898 to 1900. I was instructor in bacteriology, Sheffield School, Yale University in 1901. I was director of the Hygienic Laboratory, New York State Department of Health from 1901 to 1909.

From 1909 to date I have been consulting bacteriologist and sanitary expert, having office at 39 West 38th Street, New York City. In January 1911, I was appointed sanitary expert of the Board of Water Supply of New York City and still hold that position.

Q. Have you had any special training and experience bearing on the problems involved in these pollution cases in the State of New York and the State of New Jersey?

A. In 1894 and 1895 I made special bacteriological investigations of the Schuylkill and Delaware Rivers in connection with the studies of the water supply of the City of Philadelphia. During this same period, I made an investigation and presented a special report to the Bureau of Health of the City of Philadelphia, of a large outbreak of typhoid fever and demonstrated that the same was due to the direct pollution of the public water supply of that City by the overflow of the sewer.

From 1904 to 1905 inclusive, I personally investigated and made special reports to the State Commissioner of Health of New York, on all the large outbreaks of typhoid fever which occurred in that State during those years.

The investigations of these outbreaks led to bacteriological investigations of the pollution of practically all of the large rivers and streams in the State of New York, including the Niagara River, Oswego River, Black River, St. Lawrence River, Mohawk River and the Hudson River as far south as Poughkeepsie. During this same period, there were made under my direction, special investigations, bacteriological in character, of the water supplies of all the important cities and villages of the State of New York irrespective of outbreaks of typhoid fever.

In 1908, while still in charge of the Hygienic Laboratory of the State Department of Health, I was directed by the State Commissioner of Health, to supervise a special sanitary investigation of the oyster beds and water adjacent thereto in the State of New York.

Since May 1910, I have carried on systematic and special investigations of the oyster beds owned or controlled by the Sealship Oyster System of South Norwalk, Conn., and Boston, Massachusetts. Such beds were located in the States of Massachusetts, Rhode Island, Connecticut, New York and Virginia. I have also had sanitary supervision over the methods employed in the production, handling, packing and distribution of oysters by the Sealship Oyster System, beginning with the month of June, 1910 and extending until the middle of June, 1912.

I have carried on similar work for other large producers and distributors of oysters whose beds have been located in the States of New York, Rhode Island, Connecticut and Virginia. Under my direction and supervision, sanitary investigations have been made of oyster beds in the waters of the States mentioned, and samples of oysters and of the waters adjacent to oyster beds have been collected and examined under my direction in the Lederle Laboratories.

I have acted as a special adviser on scientific and sanitary matters to the Board of Directors of the Oyster Growers and Dealers

Association of North America during the years of 1910, 1911 and 1912.

Since June, 1911, I have made special studies and have supervised the investigations of a bacteriological character on deep sea and surface feeding salt water fish. This work has been carried on 3195 for a Committee of the Allied Salt Water Fish Industries, representing some of the large fish interests of the Atlantic coast.

During my connection with the New York State Department of Health and since that time, I have made many investigations and studies of the causes of outbreaks of typhoid fever, diphtheria and other communicable diseases, which have been determined to have been due to conditions of pollution of waters or the contamination of shell fish.

Q. Are you connected with any medical societies, Doctor?

A. I am an active member of the Medical Society of the County of Albany, an Honorable member of the Medical Society of the Counties of Rochland and Dutchess. I am a member of the New York State Medical Society and the American Medical Association. I am an active member of the American Public Health Association and am Secretary of the Sanitary Engineering Section of the same. I was Recorder of the Laboratory Section of this Association for ten years and have been for the past three years the Secretary of the Committee of this Section appointed to formulate standard methods for the sanitary examination of shell fish. I am a Charter Member of the Society of American Bacteriologists and American Association of Pathologists and Bacteriologists. I am a member of the following associations: American Association for the advancement of science; Associated Physicians of Long Island; New England Water Works Association; National Association for the study and prevention of Tuberculosis. I am also a Fellow of the New York Academy of Medicine and am at the present time the Secretary of the Section on State and Municipal Hygiene of the International Congress on Hygiene and Demography, 1912 meeting.

Q. Are you familiar with the testimony that has been given in this case?

A. I have read in full the testimony of Complainants' witnesses as to the methods of conduct of the float experiments which have been presented graphically in Complainants' Exhibits 4, 5, 6, 7, 8, 9, 10, 11, 61 and 62.

3196 Q. Have you made examination and studies of the testimony of the previous witnesses given for the Complainants?

A. I have.

Q. State to what extent, Doctor?

Mr. Riker: The question is objected to as an improper way of calling for testimony in the case, as being immaterial and irrelevant.

The Commissioner: Note the objection of Counsel for Defendants.

Mr. O'Sullivan: I withdraw the question.

Q. Have you made any personal inspections of the waters of New

York Lower Bay, especially those in the neighborhood of the Great Kills and on the Staten Island shore?

A. I have.

Mr. Riker: Excuse me, Doctor, I give notice of motion to strike out all that testimony as being founded admittedly on hearsay.

The Commissioner: Note the motion of Counsel for Defendants.

A. On July 13th, 1908, I made an inspection of the waters of this region with the special object of determining by personal observation and by interrogation of experienced oystermen and sailing masters of vessels engaged in the oyster industry, as to the general directions of tidal currents in the waters of the Lower Bay, and with the particular object in view of determining whether the sewage passing from the upper to the lower bays during the ebb tide would, under average conditions, be carried directly to the oyster beds south of Great Kills, or would be indirectly carried to this same region. As a result of this inspection and of the information gathered by me personally at that time, I arrived at the conclusion that the sewage polluted waters passing through the Narrows on the ebb tide would, under average conditions as to winds and
3197 tidal currents, not pass directly over the oyster beds south of Great Kills, but that the presence of any sewage polluted waters in the vicinity of Sandy Hook at the turn of the ebb tide would, as a general rule, be carried back upon the flood tide, at least in part, to the oyster grounds south of Great Kills.

Mr. Riker: The same motion in regard to that testimony.

The Commissioner: Note the motion of Counsel for Defendants.

Mr. O'Sullivan: That excludes his own observations that have been described?

Mr. Riker: The motion only extends so far as the motion itself indicates.

Q. Proceed, Mr. Pease?

A. On May 4th, 1910, in company with the officers of the Seal-shipt Oyster System, I made a tour of inspection of the waters south of Great Kills, Staten Island and again investigated this same problem, both by personally observing the direction of the current of the incoming tide, which on that day reached full flood during the latter part of the afternoon, and by personally conferring with A. K. Cole, Vice President of the Sealshipt Oyster System, in charge of the oyster grounds of that company south of Great Kills and determined again that the general trend of the flood tide was from Sandy Hook in a northwesterly direction to the oyster beds south of Great Kills. On this trip, various stops were made by the steamer and oysters were dredged. While the engines of the boat were not in motion, the steamer was carried by the force of the tidal current and always in a northwesterly direction.

Q. Doctor, you state that you were directed by the State Commissioner of Health to plan and supervise a complete investigation of the sanitary conditions of the oyster beds in New York
3198 State waters in 1908. Will you state the reason why you undertook these investigations?

Mr. Riker: The question is objected to as being based on hearsay testimony and not relevant or material to this issue.

The Commissioner: Note the objection of Counsel for Defendants.

A. This investigation was undertaken in compliance with Section 214 of the Forest Fish and Game Law, then upon the Statute Books.

Mr. Riker: I move to strike this testimony out as being an attempt by this witness to testify as to what the law of the State of New York is.

The Commissioner: Note the motion of Counsel for Defendants.

Q. Will you state whether you had any help and assistance in this investigation?

A. I had the assistance and co-operation of the Engineering Division of the New York State Department of Health, under the supervision of Mr. Theodore C. Horton, Director of that Department.

Q. What portion of the work in this investigation was actually conducted by the staff of the Engineering Division of the State Department of Health?

A. The detailed sanitary inspections of all the shores, bordering upon the tidal waters and the streams running into the same, the making of special determinations as to the direction of tides and currents.

Q. What portion of the investigation was made directly under your supervision?

A. The collection and bacteriological examination of samples of water and of shell fish. These collections and examinations were planned by me in conference with the chief chemist of the State Hygienic laboratory, and the work was conducted under the immediate supervision of the chief chemist, Mr. L. M. Wachter.

3199 Mr. O'Sullivan: I withdraw this witness for a moment until I put Mr. Wachter on the stand.

LEONARD M. WACHTER, a witness called on behalf of Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Are you connected officially with any of our State Departments, Mr. Wachter?

A. I am Sanitary Chemist of the State Department of Health.

Q. Are you Chief of the Chemical staff?

A. I am.

Q. Where did you study?

A. Rensselaer Polytechnic Institute, Troy, New York.

Q. Professor William P. Mason, was he a teacher in that Institute at the time that you studied there?

A. He was. He was my Professor in Chemistry at that time and I learned my sanitary water chemistry under him and he was considered one of the fathers of Sanitary Water Chemistry.

Q. You heard Dr. Pease testify?

A. I did.

Q. Now, will you detail the special features of the investigation that you conducted, stating how you secured the samples of both oysters and water and what you did with them?

A. That is relative to this specific location?

Q. Yes.

A. I made one trip to the vicinity of Raritan Bay, that is the vicinity of the Great Kills and from there around to Tottenville, with Dr. Pease, and a Mr. Merrell, who was an oysterman, having oyster beds in that vicinity, and at that time we observed the general conditions so as to plan the laboratory work. Later a laboratory was established at the Brooklyn Polytechnic Institute, and I personally accompanied by a laboratory assistant and the same Mr. Merrell, and a captain who ran the boat,—I have forgotten his name, but he was a partner of Mr. Merrell in these particular 3200 oyster beds owned by Mr. Merrell in that locality. We went out and collected samples of water and of oysters from Great Kills in a general southerly direction to the south point of Staten Island and samples of water were taken from across the mouth of the Arthur Kill, from the point of the Southern extremity of Staten Island off the Jersey shore in the vicinity of Cheese Creek.

Q. What did you do with these samples, the samples of oysters when you raised them to the surface of the water. What next did you do with them?

A. I had a map, a Government map of that locality, and by the aid of the captain of the boat, who as I said before, knew the location of the individual beds, located on the map the points, using the stakes, showing the oyster men's individual holdings, and the Government light and the points on shore as references, in that way we fixed the point from which the samples were taken and located them on the map.

Q. One moment, have you got that map with you?

A. Yes, sir, I have it here.

Q. And those writings on that map are they in your handwriting?

A. Yes, sir, they are. There are lead pencil figures that are in my handwriting, and they are the field figures that I put down at the time that the samples were taken. At a later time in my own handwriting, ink indications were placed on those points indicated by lead pencil at the time that the work was done.

Q. Is that map part of the state records of your department?

A. Yes, sir, it is the map upon which the locations were taken that are shown in the published reports of this investigation.

Q. Have you got a duplicate of that map?

A. I have here a printed copy showing the details, and I have compared the locations and the numbers on this printed copy with the original map which I made in the field.

3201 Q. And how do they compare?

A. They agree.

Q. Is it a correct copy? It is as far as one is able to judge by the eye, yes, sir, it is. The figures and the locations agree.

Mr. O'Sullivan: I offer that map in evidence and ask that it be marked Complainants' Exhibit No. 181 in evidence.

Mr. Riker: Which one are you offering, Doctor?

Mr. O'Sullivan: The copy. I am not permitted to offer the other.

Cross-examination by Mr. Riker:

Q. You say this is in your opinion a copy of the original?

A. Yes, sir.

Q. Is it the same size?

A. No, sir, it is not.

Q. Does it contain the same detail?

A. It does.

Q. In all respects?

A. In all respects as one is able to judge by the eye.

Q. Will you hand me the original please. (Counsel examines the original.)

Q. I draw your attention to the portion of the original map marked "Upper Bay" and I ask you whether the figures that appear there are reported on what you claim to be a copy?

A. No, sir, they are not.

Q. And in the Lower Bay, are the figures that appear on the original reported in the copy?

A. No, sir, they are not.

Mr. Riker: I object to the offer on the ground that it is not a copy and is not properly proved.

The Commissioner: Note the objection of Counsel for Defendants.

Mr. O'Sullivan: Complainants' Counsel desires to state that this map is offered not as an exact duplicate of the original map, but for the purpose of showing the oyster beds located in these waters and from which he obtained samples.

3202 Direct examination by Mr. O'Sullivan (resumed):

Q. Do the locations from which you obtained the samples appear accurately on this copy of the map?

A. They do, as far as I am able to judge by the eye, and the numbers indicating the sample stations are there. The water depths are not located on this copy.

Mr. O'Sullivan: I renew the offer.

Mr. Riker: I renew the objection.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 181.

Marked Complainants' Exhibit No. 181.

Q. You may proceed and tell what you did with the oyster samples that you took from these locations that are indicated on this exhibit, Complainants' Exhibit No. 181?

Mr. Riker: The question is objected to because it does not appear that he took any oysters from points shown on this exhibit.

The Commissioner: Note the objection of Counsel for Defendants.

Q. Did you take oysters from the locations indicated on Complainants' Exhibit No. 181?

A. I did.

Q. State what you did with them when those oysters were raised to the surface of the water?

A. When the oysters were taken out of the water, the oysters from a given point were put into an individual tin can. That had a screw cap cover. In the can along with the oyster was placed a tag, and on that tag was the same number that was placed upon the map. The cover of the box was then closed and after the series of samples were taken from a number of locations, the boxes containing the individual series, were, when in my possession, or that of my assistant, carried to Great Kills, and in some instances by boat to Tottenville, where the train was taken and they were brought to Brooklyn by me and my assistant, and immediately upon arriving at the Polytechnic Institute, where our laboratory was located, the samples were placed in refrigerators for the night.

Q. What did you next do with those samples of oysters?

A. The following morning after the samples were taken, the oysters selected from any given sampling point were scrubbed with a brush and thoroughly cleaned with tap water. After they were so washed and dried with a towel, at a point on the oyster shell near the hinge where the oyster shell usually forms the deepest cavity, it was flamed with a Bunson gas flame to sterilize it. A steel drill was then sterilized in the same manner by flaming it with the gas flame and a hole was drilled partly through the oyster shell. After the hole was partly drilled through the drill was freed from the chips of oyster shell and again flamed with the Bunson flame, and the oyster shell also flamed the second time with the gas flame. The hole was then drilled completely through to expose the interior of the oyster shell. With a sterile pipette, or with sterile pipettes, different volumes of the oyster liquor were taken out, and either inoculated directly into Jackson's bile media, or else diluted with sterile water and those dilutions placed into the bile media for fermentation. These inoculations of oyster liquor, or the dilutions of the oyster liquor were then incubated in an incubator to find if fermentation of the lactose contained in the media took place. If fermentation did take place, with a sterile platinum loop, portions of these cultures were inoculated into lactose azolitmin agar plates. If the colonies that grew in or upon these azolitmin agar plates were typical red colonies it was considered that the oyster liquor in the fermentation tube contained organisms of the B. Coli type.

Q. Who was the Dr. Jackson that you mentioned?

A. Dr. Jackson is Dr. Daniel D. Jackson,—I know his name is Daniel. I think the second initial is D. He is director of the Mount Prospect Laboratories of the Department of

Water, Gas and Electricity of New York City. He is the one who worked out the so-called Jackson bile media, which is now and was at that time recognized as the standard media for the isolation of B. Coli by the American Public Health Association in standard methods for water analysis.

Q. Were you with Dr. Pease on any of his tours of inspection of the waters of the Great Kills?

A. I previously testified that Dr. Pease accompanied me in my first trip to the Great Kills along with Mr. Merrell who was an oyster man with interests at that point, and a captain, who I was told at that time was his partner, who operated the boat.

Q. Did you make other trips by water or otherwise to the section you were just testifying about for the purpose of collecting samples of oysters for bacteriological examinations?

A. I took many series of samples and each series as I remember would take more than one day. That is we only took on a given day the number of samples that could be handled in the laboratory the following day.

Q. Were these examinations under your immediate supervision and did you participate in the making of them?

A. The local laboratory, by that I mean the one at Brooklyn, because the Department laboratory was at Albany, was under my immediate supervision, and all the work was done by me and my immediate assistants. All the samples collected were made in my presence and I accompanied the samples each time to the laboratory.

Q. Did you have charge of the recording of the results of these examinations, and did you participate in the preparation of the official report showing the results of these examinations?

A. The records were entirely in my charge until the work was completed, and the laboratory equipment and records taken to Albany, and I participated in making the reports.

3205 Q. And did you submit the report of the results of these examinations of the samples which you collected from the waters of Raritan Bay and Great Kills and that vicinity?

A. I reported them direct to Dr. Pease who was director of the laboratory, and my immediate chief.

Q. Mr. Wachter, does any official state report contain a description of the methods employed by you and under your supervision for the bacteriological examination of the samples of water and oysters?

A. To my immediate knowledge at the present time, I do not think there was, except that the reports state the indications of the tables, contain tabulations of the results.

Q. Does any official report contain the tabulations of the results of your examinations made by you of the samples of water and oysters collected by you from the waters of Raritan Bay and the Great Kills and that vicinity?

A. The 29th Annual Report of the State Department of Health, Volume 2, for the year 1908, contains a report of the oyster investigation and as part of that report are the tabulations concerning

the results of the laboratory findings on samples of water and oysters, taken from Great Kills and vicinity.

Q. By you?

A. Yes, sir. The samples and the work was done by me and my assistants.

Q. Mr. Wachter, I direct your attention to Complainants' Exhibit No. 181, and ask whether there are indicated on that exhibit the approximate locations of the points from which the samples of water and oysters were collected by you and under your supervision during the investigation you have just testified to?

A. They are.

Q. In what way?

A. They are indicated by circles, some solid and some simply a dark ring and an arrow pointing to these circles direct attention to the numbers. These numbers are followed each by a decimal point, and the decimal 1 or the decimal 2 indicates respectively 3206 the sample number or either water sample or the points from which oysters were taken, .1 indicating water samples, and .2 indicating the oyster sample stations.

Q. Mr. Wachter on what page of Volume 2 of the 29th Annual Report of the State Department of Health of the State of New York for the year 1908, do the tabulations that you have just testified to as representing your work appear?

A. They appear on page No. 892.

Mr. O'Sullivan: Instead of offering this entire volume which contains much irrelevant matter to the purpose of my present inquiry, I offer that portion of the 29th Annual Report, Volume 2 for the year 1908 of the State Department of Health of the State of New York, I offer that portion of it, which I have had separated out from one of these reports dealing entirely with the sanitary inspection of the shell fish grounds that have been testified to. I offer it in evidence and ask that it be marked Complainants' Exhibit No. 182.

Mr. Riker: What do you know about this offer, Mr. Wachter?

The Witness: I do not know anything about that particular thing.

Mr. O'Sullivan: Leave the stand a moment, Mr. Wachter. I withdraw my offer.

HERBERT D. PEASE, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. I hand you what purports to be the 29th Annual Report of the State Department of Health of the State of New York, Volume 11 for the year 1908, and ask if you separated from a similar volume that portion of the volume that deals with the sanitary inspection of shell fish grounds?

A. I did.

3207 Q. Have you got it with you?

A. I have.

Q. Did you have that portion of the volume separately bound?

A. I did.

Q. And it contains no other matter than the maps and tabulations of the work of the sanitary investigation of the shell fish grounds?

A. None whatever.

Mr. O'Sullivan: I offer this in evidence and ask that it be marked Complainants' Exhibit No. 182.

Mr. Riker: The offer is objected to as being immaterial and irrelevant, the matter supposed to be introduced in this form not having been proved in any way by any witness competent to testify to it.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 182.

Marked Complainants' Exhibit No. 182.

Mr. O'Sullivan: That is all, Doctor.

LEONARD M. WACHTER a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. I now direct your attention, Mr. Wachter, to page 892 of Complainants' Exhibit No. 182. I ask you if you personally compiled the results of the investigations which appear on the table on page 892?

A. I did.

Q. Now, before the State Department finally issued that tabulation in the form in which you have it in your hand, was the proof of the report, of that portion of the State Department report, submitted to you, and did you compare it with the original notes showing the results of the examinations of the samples obtained from Raritan Bay and Great Kills and vicinity, and were they corrected?

3208 A. I compared the results in all portions of the report which refer to the oyster investigation.

Mr. O'Sullivan: That is all. You had better cross examine this witness. I had to get him down last night from Albany on a hurry call.

HERBERT D. PEASE a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. You heard the testimony of the preceding witness, Mr. Wachter?

A. I did.

Q. Were the results of the investigation carried on under your supervision and his immediate direction, insofar as the bacterial examinations of samples of waters and oysters from the Raritan Bay and the Great Kills and vicinity transmitted by him to you?

A. They were.

Q. Did you include that in any official report made by you as the result of this investigation?

A. I did.

Q. Will you examine Complainants' Exhibit No. 182 and state whether it contains the report made by you of this investigation?

Mr. Riker: The question is objected to because of the use of the so-called exhibit, the exhibit not having been properly proved or admitted.

The Commissioner: Note the objection of Counsel for Defendants.

Q. Proceed, Doctor?

A. Beginning with page 834 and including the intervening pages to the bottom of 861, and then beginning a new paragraph at the bottom of page 862 and extending to the end of the first paragraph on page 864 contains portions of the report actually written by me.

The results presented on page 892 under the title "Oyster 3209 Cultivation, District No. 14, Raritan Bay," were transmitted by me to the Engineering Division of the State Department of health and were finally incorporated in the Appendix to the Report which was prepared by that Division, beginning Page 865. However, the proof sheets of this entire report were submitted to me prior to publication and were carefully scrutinized and the tabulated results were transmitted to Mr. Wachter for comparison with his original notes.

Q. Have you examined the tables appearing on pages 58 and 56 of Complainants' Exhibit No. 2, being the report of the New York Bay Pollution Commission dated March 31st, 1905?

A. I have and I have also read with care the statements appearing in Exhibit 2, beginning at the bottom of page 48 and continuing to the bottom of page 57.

Q. You have testified that you made investigations of the sanitary conditions and surroundings of the oyster beds owned by a number of your clients?

A. As already stated in my testimony, I have made a large number of special investigations in many parts of the country, but I have given special attention to the investigations of the sanitary surroundings and the actual conditions of oysters in certain locations, among these being the oyster beds off Great Kills.

Q. Will you describe the investigation that you made off Great Kills?

A. Investigations of the oyster beds and the surrounding waters for my clients, have consisted in the following procedure; first—a thorough examination of all the official and other records showing the results of any previous bacteriological or sanitary investigations on such oyster grounds, second—a thorough study of all 3210 available documents, official and otherwise, which would give information as to the direction of tidal and other currents and as to the meteorological conditions at seasons of the year when oysters are taken from oyster beds for transportation to market, and in general, a study of all the data which would enable me to arrive at a

conclusion as to the amount, if any, and character of pollution of the waters coming in contact with such oyster grounds. Where sufficient information could not be obtained as to sanitary conditions from official documents, complete sanitary inspections of the surroundings of these oyster beds and the territory adjacent thereto, would be made by my assistants or my associate sanitary engineer, Mr. A. J. Provost, Jr.

Following the studies of documents, it has been my custom to make one or more personal trips of inspection, to note the general surroundings and character of the waters over the oyster beds, and to hold consultations with captains of oyster boats and pilots and others familiar with the tidal and other currents, and the directions of the wind in such locations.

Still later, samples of oysters are collected, either by members of my own staff or the collection of the same is requested of the client. When the collection is requested of clients, blanks are furnished to them, giving directions for collecting oysters and samples of water for bacteriological examination; and also calling for data relating to the surroundings of the bed from which the samples are collected. I desire to submit two copies of these blanks, as part of my testimony.

Q. What information is called for in the blanks that you would submit?

3211 Mr. Riker: The question is objected to as immaterial and irrelevant, the only competent inquiry being what has been done, not what has been called for.

The Commissioner: Note the objection of Counsel for Defendants.

Q. Have you got any of those blanks with you, Doctor?

A. I have.

Q. And you produce them?

A. I do.

Mr. O'Sullivan: I offer one of these blanks in evidence and ask that it be marked Complainants' Exhibit No. 183.

Mr. Riker: The offer is objected to on the ground that this blank has not been made competent as bearing in any way on the issues in this cause.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked complainants' exhibit No. 183.

Q. Proceed.

A. It should be noted that information is called for by the blank, giving data concerning the condition of the tide at the time the sample is collected, the direction and velocity of the wind, and the character of the weather; also information as to the character of the bottoms from which the samples of oysters are taken and the depth of water over the same.

Upon the collection or the receipt of the samples of water or oysters, the methods to be pursued in the examination of samples and of recording the results of the same and of recording the data sub-

mitted by the collector of the sample, as definitely laid down by me, are pursued by my assistants and upon the completion of all examinations, the results of the same, together with all the data and information which has been collected, are re-submitted to me for final interpretation and report.

Q. Now, have you adopted that procedure in any special
3212 investigations of the oyster grounds and the oysters taken off the Great Kills for your private plans?

A. I have. Copies of these blanks have been submitted to all interested in the collection of the samples, and have been filled out by them and have been returned to the laboratory and were used by me in the drawing of final conclusions and interpretations as to the sanitary significance of the results of the examinations.

Q. Did you make any inspection trip in 1910?

A. Yes, and I have already so testified and have given testimony as to the results of personal inspection of the waters of that region made on May, 4th, 1910. Prior to that inspection, I made a thorough study of the official reports of the New York Bay Pollution Commission of 1905-1906, and again carefully reviewed the results of the investigation which had been made under my supervision of the oyster beds and oysters of this region in 1908 for the State Department of Health.

Following the inspection trip in 1910, I requested of my clients that they designate one of their employees who was thoroughly familiar with the Great Kills oyster grounds to make collections of samples of water and of oysters from the various beds owned or controlled by them, and to authorize him to make such collection at such times and under such conditions as I would subsequently indicate. They designated for this purpose Mr. George W. Sanbeg of New Dorp, Staten Island and Mr. Sanbeg has been requested by me to make not only special, but routine collections of samples of water and oysters from special sections of particular beds and likewise to make observations as to the temperature of waters over these beds and to make notes as to the direction and velocity of winds blowing at the time samples are collected, and the state of the tide.

3213 Mr. O'Sullivan: I will withdraw this witness for a few minutes and call Mr. Sanbeg.

GEORGE W. SANBEG a witness called on behalf of Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Where do you reside, Mr. Sanbeg?

A. Great Kills, New York.

Q. And that is on Staten Island?

A. Yes, sir.

Q. And what is your occupation?

A. Oyster man.

Q. What experience have you had Mr. Sanbeg in the navigation

of the waters of Lower New York Bay, especially the waters of the Great Kills and in Princess and Raritan Bay?

A. I have been around those waters continually for this past 30 years.

Q. What do you know as to the condition of the waters over the oyster beds of the Great Kills during the flood tide?

A. I do not understand the question. Sometimes it is rough and sometimes it is smooth.

Q. Well, I more particularly wish to inquire relative to the condition of the currents on the ebb tide, as to the observations that you made?

A. The way the ebb tide runs you mean?

— Yes, with regard to the Great Kills?

A. Well, it runs out of the Great Kills, but a short way, a mile or so, and it runs down towards Sandy Hook, toward Perth Amboy.

Q. Are you familiar with oyster culture in the waters along the shores of Staten Island?

A. Yes, sir.

Q. What is the direction of the flood currents in the neighborhood of the Great Kills?

A. Well, off shore away, where the Great Kills does not affect it, it comes directly from Sandy Hook. When you get in towards the Kills, of course, it is running in the Kills in the harbor.

3214 Q. How are the oyster beds indicated in that region?

A. Stakes and buoys.

Q. Who sets out the oyster beds?

A. The Engineer of the Fish Commissioners locates the corners of the various grounds.

Q. Are there stakes to indicate the lines from buoy to buoy?

A. Yes, sir.

Q. Have you collected samples of oysters at the instance of Dr. Herbert D. Pease?

A. Yes, sir.

Q. Will you state how you collected them?

A. Yes, sir.

Q. From what region?

A. Well, just west of Great Kill, southwest of Great Kills would be about the course.

Q. Are these beds numbered?

A. Yes, sir.

Q. What bed numbers did you take from?

A. No. 490 mostly. We have been taking all from 490 lately. We have taken some from the various beds at different times.

Q. Now, what did you do with the samples after you removed them from the bay, from the oyster bed?

A. Took them to Dr. Pease. That is what you mean, I suppose.

Q. Yes, just tell us how you removed them, what you did with them?

A. Put them in a boat and took them over. They were tied up sometimes in a little bag, sometimes in paper, and took them to Dr. Pease.

Q. Have you got any list that will show when you took these samples?

A. Yes, sir.

Q. Have you got it with you?

A. Yes, sir.

Q. When did you collect samples for Dr. Pease, just state, Mr. Sanbeg?

A. Well, there are a lot of them here. Do you want them all?

Q. Have you got any more lists?

A. Not for 490. These are for 924 on this other list.

Q. This first list, what does it show Mr. Sanbeg?

A. That shows the day that the samples of water were taken from No. 490.

3215 Q. And delivered to whom?

A. Dr. Pease.

Q. Who directed you to secure the samples?

A. Dr. Pease.

Q. And where did you deliver them?

A. To the Lederle Laboratories at 38th Street.

Q. Who prepared that list?

A. Well, I checked this up here. This here was given to me and then I compared it with my diary and with the original reports that I had surrendered with the oysters.

Q. How do they compare?

A. All right. Every one that has a check mark there, sir, is correct.

Q. What do those items show, the particular dates?

A. Yes, sir, the dates.

Q. Upon which you collected the samples?

A. Yes, sir.

Q. Does it show the time?

A. Well, not all of them. In the original report that I gave to Dr. Pease with the oysters, it does tell the time that the sample was taken.

Mr. O'Sullivan: I offer this list produced by this witness, indicating the dates on which he secured water samples for the purpose of analysis, for Dr. Pease.—I offer it in evidence and ask that it be marked Complainants' Exhibit No. 184.

Cross-examination by Mr. Riker:

Q. Is this your handwriting?

A. No, sir, only the check marks.

Q. Is it a copy of any document or memorandum in your own handwriting??

A. Well, most of it is, yes.

Q. I ask you whether it is a copy of any memorandum in your own handwriting?

A. A copy, yes, for the whole of it? Not the whole of it.

Mr. Riker: I object to the offer.

The Witness: I am willing to swear that I took samples on each of those dates.

3216 Mr. Riker: Very well, there is no objection to your swearing to that. What I object to is this particular offer on the ground that it is not evidential in the case and at best the original could but be used to refresh this witness' memory.

The Commissioner: Note the objection of Counsel for the defendants. Received and marked Complainants' Exhibit No. 184.

Marked Complainants' Exhibit No. 184.

Direct examination by Mr. O'Sullivan (resumed):

Q. This second list that you produce, Mr. Sanleg, headed "Oysters" what does that purport to show?

A. That means that I took samples of oysters on that day and date.

Mr. O'Sullivan: I offer that list in evidence and ask that it be marked Complainants' Exhibit No. 185.

Mr. Riker: The offer is objected to because there is nothing in the testimony as yet which would even tend to make it competent evidence.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 185.

Marked Complainants' Exhibit No. 185.

Q. What did you do with the samples of oysters that you just testified that you gathered on the dates as set forth in Complainants' Exhibit No. 185?

A. Took them to Dr. Pease.

Q. Where?

A. 38th Street.

Q. What laboratories?

A. The Lederle laboratories.

Q. Did you collect any other samples of water or oysters for Dr. Pease, which you delivered to him at the Lederle laboratories or elsewhere?

A. Other than those noted here?

Q. Yes.

3217 A. Perhaps so, at different times. May be two or three years ago. I will not be sure about that. I have taken samples there at different times.

Q. Have you got a list of any of those other samples?

A. No, sir, I do not think so—yes, I have sure. Here is one for No. 924. Those are for No. 490 and they were taken at different times, and then of course at other times they were taken at other beds.

Q. These lists relate to two beds?

A. Yes, sir.

Q. Complainants' Exhibits Nos. 184 and 185 relate to what beds?

A. That is bed No. 490, yes, both of those, 490.

Q. Both the samples of water and oysters were taken from bed No. 490?

A. Yes, sir.

Q. In those two exhibits?

A. Yes, sir.

Q. Have you got lists of any other samples of water or oysters?

A. Yes, sir.

Q. That you collected for Dr. Pease?

A. Yes, sir.

Q. Have you got a list of water samples taken from bed No. 924?

A. Yes, sir.

Q. For Dr. Pease?

A. Yes, sir.

Q. And you produce the list showing the time and date of the collection?

A. Yes, sir.

Mr. O'Sullivan: I offer that list in evidence and ask that it be marked Complainants' Exhibit No. 186.

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 186.

Marked Complainants' Exhibit No. 186.

Q. Do you also produce a list showing the dates and the times at which you collected oyster samples which you say you delivered to Dr. Pease?

A. Yes, sir.

3218 Q. And from what bed was that taken, those samples?

A. 924.

Mr. O'Sullivan: I offer that in evidence, the list of the oyster samples taken from Bed No. 924 produced by this witness and ask that it be marked Complainants' Exhibit No. 187.

Cross-examination by Mr. Riker:

Q. What is that a list of?

A. That is a list of oysters from Bed No. 924.

Q. Where does it say anything about oysters on that alleged list?

A. What is this at the top? (indicating.)

Q. Do you think that is a list of oysters collected, do you?

A. Yes, sir.

Mr. Riker: The offer is objected to for the same reasons, and on the ground that the exhibits shows it is not what the witness says it is.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 187.

Marked Complainants' Exhibit No. 187.

Direct examination by Mr. O'Sullivan (resumed):

Q. On the occasions when you took these samples of water and the samples of oysters, did you take the temperature of the water?

A. Lately, for these last 6 months perhaps.

Q. Did you note the conditions of the wind and tide?

A. Yes, sir.

Q. When you say lately, what do you mean in relation to the temperature, since when?

A. Why this last 6 months perhaps.

Q. And as to the conditions of the wind and tide?

A. We always took that.

3219 Mr. O'Sullivan: I am through with this witness, Mr. Riker. Do you want to ask him any cross questions?

Mr. Riker: No.

HERBERT D. PEASE, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. Did you hear Mr. Sanbeg testify, Dr. Pease?

A. I did.

Q. As to the delivery of the samples which Mr. Sanbeg testified he gave into your custody at the Lederle Laboratories, what did you do with them?

A. I have already testified that the staff of my laboratory have and do receive from me from time to time specific instructions as to the methods to be pursued in the examination of samples of oysters and of water, and the methods to be followed in recording the results of the same, and in the recording of the data submitted by clients or that collected and recorded by members of the staff. The same course has been pursued in the handling of the samples brought to the laboratories by Mr. Sanbeg.

Q. Who had the immediate direction of the carrying out of those instructions issued by you relative to those samples?

A. My chief assistant, Mr. L. C. Himebaugh, has entire charge of the conduct of the bacteriological work of the Lederle Laboratories, under my direction. It was his duty to supervise the examinations of the samples of water and oysters brought to the laboratory by Mr. Sanbeg, and the recording of the data.

Mr. O'Sullivan: I want to put Mr. Himebaugh on the stand.

LESTER C. HIMEBAUGH, a witness called on behalf of Complainants, being first duly sworn, testified as follows:

3220 Direct examination by Mr. O'Sullivan:

Q. Where do you reside, Mr. Himebaugh?

A. At Brooklyn Manor, Long Island.

Q. What is your occupation or vocation?

A. Assistant bacteriologist and Assistant Director of the Department of Bacteriology, Lederle Laboratories.

Q. How long have you been assistant in the Lederle Laboratories?

A. Since March 8th, 1909.

Q. Under whose particular direction are you there?

A. Under Dr. Pease.

Q. Will you state where you received your education and experience and other qualifications that qualify you as a bacteriologist?

A. I received the degree of A. B. from Colorado College in June 1906, during the next two college years I completed the first two years' work at the Harvard Medical School leading to the degree of M. D.

Q. Did you take that degree?

A. I did not complete the course. The two years' work there was directed more especially along the line of public health work. Since March 8th, as I have already testified, I have been actively engaged in bacteriological work in the Department of Bacteriology of the Lederle Laboratories.

Q. Did you hear the testimony given by Mr. George W. Sanbeg who was on the stand a few moments ago?

— I did.

Q. Did you receive from Mr. George W. Sanbeg samples of oysters and water and information from Mr. Sanbeg as to the condition of the tide, wind and temperature of the water at the time the samples were collected by him, which he delivered by you?

A. Either Dr. Pease or myself in the same place received the samples, which were delivered by Mr. Sanbeg.

Q. Did you make a bacteriological examination of any of the samples delivered to you by Mr. Sanbeg?

— I did.

Q. Under Dr. Pease's direction?

A. I did.

Q. What method did you employ in the bacteriological examination that you conducted of these samples of water and oysters referred to?

A. The method employed in the examination of oysters was as follows: The oyster was in each case thoroughly scrubbed and rinsed in tap water. The greater portion of the edge of the oyster shell was then passed through the flame of a Bunson burner several times.

Q. For what purpose?

A. For the purpose of sterilizing the edge, in order to not introduce outside organisms into the shell liquor of the oyster in the process of opening.

Q. How did you open them?

A. The oysters were then opened by means of a sterile oyster knife and amounts of shell liquor ranging from 1 c. c. to 1/100 c. c. transferred under aseptic precautions into separate Smith fermentation tubes containing sterile lactose peptone bile. The same operation was repeated on five oysters. The Smith tubes which had been inoculated were then incubated for a period of 72 hours at 37° C. At the end of 24, 48 and 72 hours observations were made as to the presence or absence of gas in the closed arm of the fermentation tube. Where as was found, the percentage was determined. In such cases isolation of the gas producing organism was in each case attempted, by making litmus lactose agar plates from the

diluted lactose peptone bile and after incubating the plates for 24 hours 37° C. colonies which resembled those of the *Bacillus coli* type were isolated on standard infusion agar and the following cultural characteristics determined.

First, the production of indol was determined in a 1 per cent. solution of peptone.

Second, the reduction of nitrates to nitrites was determined in a solution of nitrite free nitrates, to which had been added 1/10th of 1 per cent. of peptone.

Third, the production of gas in lactose agar was determined by making a stab inoculation of lactose agar.

The cultural characteristics above referred to were determined at the end of 4 days' incubation at 37 degrees C.

The samples of water which were received the same time as samples of oysters were examined by me or by my assistant under my direct supervision, in the following manner:

Five fermentation tubes containing a 1 per cent. solution of dextrose broth were inoculated in the following manner:

2 fermentation tubes were inoculated with 1 c. c. of water each.

3 fermentation tubes were inoculated with 1/10 c. c. of water each.

5 fermentation tubes of lactose peptone bile were inoculated in the following manner:

3 tubes with 10 c. c. each, the two remaining tubes were inoculated with 1 c. c. each.

The fermentation tubes were then incubated for 72 hours at 37 degrees C. Observations were made at the end of 24, 48 and 72 hours and when the presence of gas was observed in the closed arm of the fermentation tube, the percentage was determined and isolation of *B. coli* attempted in the same manner as described under oyster examination above.

A study of the cultural characteristics of the isolations made was also made in the same manner as described under oyster examination. The results obtained on these examinations by myself or by my assistant under my direct supervision, were recorded on laboratory cards printed for that purpose.

Q. How were these results arranged for interpretation?

A. The results which were obtained in the manner described above were then arranged for interpretation in accordance with the methods described for the examination of shell fish, published in the Journal of the American Public Health Association, known as the standard method for examination of shell fish.

Q. Now, to whom did you submit the results of this work that you have testified to and which you state you did under the immediate direction of Dr. Pease?

A. After making a preliminary arrangement of the findings, I referred the final interpretation of the results obtained to Dr. Pease.

Q. Did you arrange in any fashion the information given to you by Mr. Sanbeg and the results of your bacteriological determinations on the samples that he submitted?

A. I have. This information which was given to me by Mr.

George W. Sanbeg, together with the results which were obtained in the laboratories have been recorded here in the order in which the samples were received at the laboratories, and as complete information as we were able to obtain was tabulated by me in these papers.

Q. Have you checked off these tabulations with your laboratory note books?

A. These tabulations have in each case been checked with the original data submitted by Mr. Sanbeg and with the laboratory notes from each individual examination.

Q. Do you now produce a report *obtaining* the matter you have just testified to in the form in which you have testified that they exist.

A. I do.

Mr. O'Sullivan: I offer the report in the matter of the results of bacteriological examinations of samples of oysters and water collected by Mr. G. W. Sanbeg as testified to by him from the waters of oyster bed No. 490 for the Bureau of Marine Fisheries and Conservation Commission of New York State and delivered by him to this witness in the laboratory, as this witness has testified. I offer that in evidence and ask that it be marked Complainants' 3224 Exhibit No. 188.

Cross-examination by Mr. Riker:

Q. Will you take this first table and indicate what part of it represents your own personal work?

A. I am unable from memory to state just what the parts are which were my own personal work, but the entire work in every particular was under my direct supervision.

Q. Can you point out any part of it which is your own personal work?

A. Not from memory. If I had with me my original note books I could point out just what work was entirely my own. I can say that the weather conditions — the tide data has been given to me by Mr. Sanbeg. The remaining data has all been carried on either by myself or under my direct supervision.

Q. The second column, date of collection, that was carried on by you under your supervision?

A. Yes, sir.

Q. Were you present when they were collected?

A. NNo, sir, I complied that from the data which I had.

Q. Who furnished the data to you?

A. Mr. Sanbeg.

Q. How does it differ from the direction and the velocity of the wind and the tide so far as the source of your information is concerned?

A. I do not just understand your question.

Q. How does the data that is supposed to be contained in Column 11, the second column headed "Date of Collection" differ, so far as the source from which you received it is concerned, from the next

column, the tide, and the next column the direction of the wind and the velocity of the wind?

A. They coincide as far as the information which I have received goes.

Q. Did you check it up in any way?

A. I have checked it up with Mr. Sanbeg's original notes and found that they agree.

Q. That is all the checking up you did?

A. And then we have the checking from his original 3225 data submitted with the sample, the hour of collection and the date.

Q. I am asking you what you did. What other checking did you do?

A. I have checked the entire remainder of the results outside of what Mr. Sanbeg has given, with the original data obtained, either by myself or by one of my assistants under my direct supervision.

Q. How many of those samples were actually received by you from Mr. Sanbeg on this sheet, I am now showing you the first sheet, the first table?

A. I cannot say from memory. In fact I do not believe it has been recorded whether I received the sample or whether Dr. Pease received the sample.

Q. Well, you have said that you cannot say, have you not, how many you received?

A. Yes.

Mr. Riker: The offer is objected to on the ground that it is not properly proved.

The Commissioner: Note the objection of Counsel for Defendants.

Received and marked Complainants' Exhibit No. 188.

Marked Complainants' Exhibit No. 188.

Direct examination by Mr. O'Sullivan (resumed):

Q. Did you prepare any other reports on these samples Mr. Himebaugh?

A. I have prepared also a tabulation of information given to me by Mr. G. W. Sanbeg, together with the results obtained on the samples submitted by Mr. Sanbeg from beds 924 and other beds designated by the Bureau of Marine Fisheries Conservation Commission, New York State, as lying in Raritan Bay.

Q. The copy of the report that you hand me, Mr. Himebaugh, did you check off the items with the original laboratory notes and with the original data that you received from the collector of the sample?

A. I did.

Mr. O'Sullivan: I offer the report in the matter of the 3226 results of bacteriological examinations of samples of oysters, collected by Mr. G. W. Sanbeg from the waters of oyster beds, designation of the Bureau of Marine Fisheries Conservation

Commission of New York State in Raritan Bay, and delivered by him to this witness. I offer it in evidence and ask that it be marked Complainants' Exhibit No. 189.

Mr. Riker: The same objection as to the last offer.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 189.

Marked Complainants' Exhibit No. 189.

Q. This report purporting to give the results of the bacteriological examinations of the samples of oysters and water collected by Mr. Sanbeg from the waters of oyster bed No. 924, did you prepare that in a way similar to the other reports that have been offered in evidence through you?

A. I did.

Q. And used the same method of checking the items?

A. I did, in each case.

Mr. O'Sullivan: I offer that in evidence and ask that it be marked Complainants' Exhibit No. 190.

Mr. Riker: The same objection as to the last offer.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 190.

Marked Complainants' Exhibit No. 190.

Q. Who directed you to make these tabulations that have been put in evidence through you and are marked as Complainants' Exhibits Nos. 188, 189 and 190?

A. Dr. Pease.

Q. Did you cause the data set forth in Complainants' Exhibit No. 188 to be plotted in graphic form, together with the other data relative to those oyster samples?

A. At the direction of Dr. Pease I prepared these in the form of a chart, and the chart which I have is a copy of the original.

Q. Did you compare it with the original yourself?

A. I have compared it with the original and have initialed it.

Q. And how do they compare?

A. It compares in all details as far as I was able to see.

Q. It is a blue print?

A. A blue print of a tracing. The original tracing was compared by me with the original data and in every detail it checked. The chart represents in graphic form the number of B. Coli per cubic centimeter in the samples of water delivered to the laboratory by Mr. Sanbeg, together with the number of B. Coli per cubic centimeter in the shell liquor in oysters submitted by Mr. Sanbeg. The temperatures of the water were given to me by Mr. Sanbeg, and I have in addition taken from the monthly summary issued by the Weather Bureau of the United States Department of Agriculture, the observations made in New York City. The mean temperatures for each day I have recorded here, and also the entire rainfall designated in inches, and the snowfall designated in inches, tabulated in accordance with the days of each month.

Q. Did you prepare an original draft, which was the basis of the tracing?

A. I assisted in preparing a portion of this draft. The draft was prepared in my presence and every detail as to the day and readings, which are shown in this chart have been checked by me.

Q. Personally?

A. Personally, and have been found correct.

Mr. O'Sullivan: I offer the graphic chart produced by this witness in evidence as now described by him, and ask that it be marked Complainants' Exhibit No. 191.

3228 Mr. Riker: The offer is objected to for the reasons given on the last offer.

The Commissioner: Note the objection of Counsel for Defendants.

Received and marked Complainants' Exhibit No. 191.

Marked Complainants' Exhibit No. 191.

Q. Can you produce a map or chart showing the actual locations of these oyster beds alluded to?

A. I have here a map which has been given to us by the Seal-shipt Oyster System and the location of the beds as designated on this map has been checked by me with an original map in the office of the New York Marine Fisheries, 295 Broadway and the location of beds as designated on this map are the same as far as I am able to tell, as those designated on the original map.

Q. What other data appears on that map besides the locations of the oyster beds?

A. Besides the location of the oyster beds, I have tabulated under the dates on which samples were selected, the weather conditions as given to me by Mr. Sanbeg, together with the bacteriological findings of the samples of oysters submitted by Mr. Sanbeg on the dates given. The figures of the results represent the B. Coli score as given in the standard methods of the American Public Health Association.

Q. And these oyster beds that are located there are in what region, what particular locality?

A. They are here divided into four different groups, one at the mouth of the Great Kills, Bed No. 463. A second group designated here as Group 2, further off from Great Kills, and a third group designated here as Group 1.

Q. What I want to get at, Mr. Himebaugh, is where these groups are located. What vicinity?

A. I think it is indicated on the map itself over there. A Raritan Bay.

Q. What particular part of Raritan Bay?

A. Three of the groups near the Great Kills region, and one
3229 of the groups in the Princess Bay region.

Mr. O'Sullivan: I offer this map just described by this witness in evidence and ask that it be marked Complainants' Exhibit No. 192.

Cross-examination by Mr. Riker:

Q. Have you ever been on the ground Mr. Himebaugh?

A. Yes, sir.

Q. Have you located these oyster beds on the ground?

A. No, sir.

Mr. Riker: The offer is objected to on the ground that the paper is not properly proved.

The Commissioner: Note the objection of Counsel for Defendants.

Received and marked Complainants' Exhibit No. 192.

Marked Complainants' Exhibit No. 192.

Mr. O'Sullivan: Your witness.

Mr. Riker: No questions.

HERBERT D. PEASE, a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Dr. Pease, did you hear the last witness testify, Mr. Himebaugh?

A. I did.

Q. I show you Exhibit No. 2, Dr. Pease, and will ask you to compare the table on page 55, with the table on page 56, and state with what results you make the comparison?

A. I have here Complainants' Exhibit No. 2. In the table on Page 55, appear results of examinations of samples collected from points numbered 36, 37, 38, 39, 40, 41, 42, 43, 44 and 45. These 3230 samples of water were collected from the region extending from off Elm Tree Beacon on the south east coast of Staten Island to Lemon Creek on the south coast of the Island, but some distance westerly from Elm Tree Beacon.

In the table on Page 56, there appear the results of examinations of samples of oysters collected from somewhat similar although a smaller number of points extending from off Elm Tree Beacon to Lemon Creek. From the data here presented, it is impossible to state that the samples of water were collected at the same points as the samples of oysters, but for the purposes of the comparison I propose to make, it is not necessary for these points to be identical.

It will be noted from the results of tests for the presence of B. Coli in the samples of water taken from the points I have indicated, that there were no B. Coli in 10 c. c. of samples 36, 37, 38 and 39, and yet examinations of the shell liquor of the oysters collected off Elm Tree Beacon and Great Kills show the presence of B. Coli in, in the first instance, out of six oysters in 1/10 c. c. in one, in 1 c. c. in three, and 10 c. c. inoculations in four. In the latter instance, out of 10 oysters but one showed the presence of B. Coli in 10 c. c. inoculations.

The first point which I desire to call attention to in this comparison is that the shell liquor of the oysters contains a larger number of colon bacilli than in the water samples taken from the different

points. The differences, I have called attention to are not as great as are frequently found, but the significance in my opinion, is this, that the oyster in feeding, concentrates the bacteria present in the water in its gill cavities by a process which can be likened to the action of a filter. We expect, therefore, during periods when the oysters are actively feeding, to have much larger numbers of the bacteria which are present in the water, present in the shell liquor of the oysters, than are present in the water in which the 3231 oysters are feeding. I will demonstrate later with other exhibits that these differences are frequently far greater than those observed by the comparison we have made, and I shall show the reasons for these greater variations in the number of colon bacilli present in the shell liquor of the oysters than in the water surrounding these same shell fish.

Mr. Riker: I move to strike out this as being purely speculative, what this witness proposes to show has no bearing on the evidence in this case.

The Commissioner: Note the motion of Counsel for Defendants.

Q. Proceed, Doctor?

A. I desire to call attention in this Exhibit, to the fact that the samples were collected on October 22nd in both instances. I shall show later that the fact that these oysters were collected on that date is of some significance from the bacteriological standpoint.

Before leaving this subject, I desire to call attention to the fact sample 44 in the table on Page 55 is the sample of water collected from Princess Bay and that the results of the examination showed colon bacilli present in 1 and 10 c. c. inoculations. I would compare with this result, the results obtained in the examination of the sample of oysters obtained from Princess Bay on October 22nd, table on page 56, in which colon bacilli were found likewise out of 6 oysters in one instance in 1 c. c. and in two instances in 10 c. c. We find here practically no difference in the results in water system; in fact, if anything, the results of the examination of the six oysters show a smaller number of colon bacilli in oysters than the examination of the sample of water, for it is apparent that at least half of the oysters must have shown no colon bacilli whatever. In view of the presence of colon bacilli in 1. c. c. tests of the water, significance is attached to the failure to find large numbers in the oysters. Again

I would call attention to the evidence that examination of 3232 samples of water 45 and 46 on table on page 55 from Lemon Creek showed the presence of colon bacilli in 1/10 c. c. inoculations, as well as in larger amounts, and that the examination of 6 oysters which had been "drunk" in the waters of this creek on the same day, showed only 3 of them to contain colon bacilli in 1/10 c. c. inoculations, although in the use of larger volumes, of 1 c. c. and 10 c. c. practically all of the oysters showed the presence of these organisms. It is, in my opinion, worthy of note that the oysters in this instance were shown to contain smaller numbers of colon bacilli than the sample of water from the general location from which the oysters were taken. I again call attention to the fact

that the oysters were collected during the latter third of the month of October.

Q. One moment, you are talking of what?

A. Exhibit No. 2, the tables on pages 55 and 56.

Mr. Riker: I desire to object to this testimony which is based on Exhibit No. 2 on the ground that Exhibit No. 2 is not properly admitted in this case, not properly proved.

The Commissioner: Note the objection of Counsel for Defendants.

Q. Go ahead?

A. I herewith submit, as a part of my testimony, a schedule of the daily mean temperatures obtained from the Weather Bureau, U. S. Department of Agriculture, for the month of October 1904, together with the mean averages of temperatures for the month of October during the previous forty years.

Q. Where did you obtain this?

A. From the Weather Bureau of the United States Department of Agriculture.

Mr. O'Sullivan: I offer in evidence the mean temperatures taken from the Meteorological Summaries issued by the Engineering Bureau of the United States Department of Agriculture, showing the 3233 observations taken in the City of New York of the mean temperature for October 1904; also showing the average mean temperature for the month of October, 1904, and the average mean temperature for the month of October during the past forty years. I offer it in evidence and ask that it be marked Complainants' Exhibit No. 193.

Mr. Riker: It was furnished to you by the Department?

The Witness: Yes.

Mr. Riker: In this form.

The Witness: No.

Mr. Riker: Objected to as not properly proved.

The Commissioner: Note the objection of Counsel for Defendants.

Received and marked Complainants' Exhibit No. 193.

Marked Complainants' Exhibit No. 193.

Q. Have you checked the temperatures as shown in the exhibit thus produced with the original figures furnished you by the Bureau that you have stated you have obtained it from?

A. The original record was not available at the time, and those temperatures I obtained from the New York office of the Weather Bureau over the telephone, and I have had no opportunity as yet to check them.

Q. You may proceed, Doctor?

A. It will be noted that the mean temperatures for that month were generally under 60° and on the 17th, 13th, 23rd, 24th, 27th, 28th, 29th, 30th and 31st, they were under 50° F. The average mean temperature for the month was 53.3° F., while the temperature

for 40 years for the same month was 55.6° F. That temperature has a very pronounced effect upon the physiology and activity of oysters, and that other things being equal, a period of low temperature, such as occurred in the month of October, 1904, from the first almost continuously until the 18th, would tend to inhibit 3234 the feeding of oysters and thus reduce the tendency to concentration of bacteria in the gill cavities of the oysters. The conclusions which I present from a study of these two tables are that the results of the examinations of the oysters collected from off Elm Tree Beacon, Great Kills and Princess Bay as shown on table on page 56 of Exhibit No. 2, show smaller numbers of *Bacillus coli* than would be expected from the results of the examinations of samples of water from similar locations, or from the results of examinations of oysters taken from these locations during the warmer periods of the year.

Q. Now, Dr. Pease, I hand you Complainants' Exhibit No. 182 and direct your attention to page 892 of that exhibit, also to Complainants' Exhibit No. 181.

At 1 P. M. adjourned for noon recess until 2 o'clock P. M.

3235

CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, Sept. 17, 1912—2 o'clock p. m.

HERRERT D. PEASE a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan (resumed):

Q. Now, Dr. Pease, I hand you Complainants' Exhibit No. 182, and direct your attention to page 892 of that exhibit, also to Complainants' Exhibit No. 181, and ask you to compare the results of the examinations of samples of water with those of the examinations of samples of oysters for the same, or approximately the same stations and give the results obtained from the examinations of samples of both water and oysters from the respective districts from which the samples were obtained.

Mr. Riker: The question is objected to on the ground that the two exhibits named have not been properly proved and cannot be used as a basis of testimony in this case.

The Commissioner: Note the objection of Counsel for Defendants.

A. I present as a portion of my testimony a tabulation showing a comparison of results of tests for *B. Coli* in samples of water with results obtained from the examination of the shell liquor of oysters obtained from sampling stations in close proximity, the results in both instances having been taken from the table on Page 892 of Exhibit 182. This tabulation was prepared by placing under separate titles the results of the examinations of samples of water and of oysters obtained from locations approximately in the same general districts which are indicated in this tabulation as 3236 "Inside Great Kills," "Off Great Kills Point," "South from Great Kills Point," "South-west of Great Kills," "Off Princess

Bay," and the "Beds East of Tottenville."

Q. Did you prepare this tabulation yourself, Doctor?

A. I did.

Q. And verified the various figures of items in it?

A. I have.

Mr. O'Sullivan: I offer this tabulation in evidence and ask that it be marked Complainants' Exhibit No. 194.

Cross-examination by Mr. Riker:

Q. What is this tabulation based on?

A. The results as reported on page 892, and compared with the sampling stations with the same numbers on Exhibit No. 181.

Q. What part did you have in preparing either one of the series of data upon which this tabulation is based?

A. This exhibit No. 182 and 181?

Q. Yes.

A. The work done and here recorded was reported to me, and submitted by me to the State Commissioner of Health.

Q. Was reported to you, not made by you?

A. Reported to me by Mr. Wachter who has already testified.

Q. And No. 181?

A. This number 181, this chart or map was also given to me by those who were working under my supervision in 1908 in the State Department of Health and was transmitted by me to the State Commissioner of Health as part of this report.

Q. None of this was done by you as original work, was it?

A. No.

Mr. Riker: The offer is objected to for the same reasons that the exhibits themselves were objected to, that is No. 182 and 181.

The Witness: May I ask a question. When you asked me if any of the work was done, did you mean the actual physical
3237 work, not the drawing of conclusions and the mental application in the formation of this report, that was mine absolutely.

Mr. Riker: I understand. The same objection.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 194.

Marked Complainants' Exhibit No. 194.

Direct examination by Mr. O'Sullivan (resumed):

Q. Proceed.

A. There appears in the third column of Exhibit No. 194 a heading "Approximate B. Coli score." The method of representing the results of tests of the shell water of oysters for the determination of numbers of B. Coli present in them, as a score, is an arbitrary procedure recommended by The Committee on Standard Methods of Shell-fish Examination of the Laboratory Section of the American Public Health Association. I herewith present as a part of my testimony, a copy of the preliminary report of this Committee read be-

fore the Laboratory Section of the American Public Health Association in Milwaukee, in September, 1910. The determination of these scores requires that the examinations of the oysters be conducted in a particular manner, and it has not been possible to interpret the results reported in the table on Page 892 of Exhibit 182 by accurate B. coli scores, but approximations have been determined and here inserted, purely for the purpose of rendering the report of the results of tests for B. Coli more readily comparable. However, the detailed results as they appear in Exhibit No. 182 are likewise given. Considering the results of the tests on water and oysters for each particular group or district, it will be noted that in none of the tests of the samples of water, were B. Coli present, whereas in the tests of similar quantities of the shell liquor of oysters, frequent positive results were obtained. A similar result is to be noted in the

3238 comparing of the determinations on samples of water and of the shell liquor of the oysters from the samples collected off

Great Kills. The results of the examinations of five samples of water from the district "South of Great Kills Point" showed the presence of colon bacilli in volumes of 1 c. c. or smaller, in but one instance. Here, again, the results of examinations of the shell liquor of oysters showed much more frequent positive results in tests of 1/10 c. c., and in one instance, in 1/100 of a c. c. test. The results of the examinations of two samples of water from the points "Southwest of Great Kills" were positive in 1 c. c. test in both instances, but here again the oysters showed much larger numbers of B. Coli in the shell liquor. The comparison of the results of examinations of water and of oysters collected from points "Off Princess Bay" and from "Beds East of Totenville" showed these same general results. In fact, in no instance, in the results of examinations as they appear in the table on Page 892, Exhibit 182 do those of the shell liquor of oysters fail to indicate the presence of larger numbers of colon bacilli than are indicated as present in the samples of water collected from points in these same approximate locations.

In comparing the results of examinations of water and of oysters, collected from points in the groups indicated in this table, page 892, Exhibit 182 it can be said that there appears, in general, to be no definitely greater pollution in any of these sections greater than in any of the others. In other words, the distribution of colon bacilli in the waters and in the oysters from which samples were taken, appears to have certain degree of uniformity. The variations to be noted are but rarely pronounced. Samples from 3 locations gave results indicative of the presence of larger numbers of colon bacilli than were present in sample in other locations. The first of these is oyster sampling station bearing the numbers 63.2-162.2. It

3239 should be noted, however, that the oysters from oyster sampling station bearing the number 62.2-161.2, which is in close proximity, as shown by the map, Exhibit 181, while showing large numbers of colon bacilli, did not show as large a number as the first station mentioned. I conclude that the results obtained in the examination of a sample from the first station mentioned are either due to some special local condition at that point, or that the re-

sults were due to unusual conditions present at the time the samples were collected. It is well known that samples from channels or deep depressions in oyster grounds which are washed by waters containing sewage pollution, will show relatively larger numbers of colon bacilli than will samples collected from adjoining flats or nearby points.

The second and third locations to show unusual numbers of *B. coli* in the shell liquor of oysters, p. 892, Exhibit 182, are 103.2-.65.2 and 104.2-166.2 beds off Princess Bay and East of Tottenville. The results obtained from the examinations of the samples from these two locations can be attributed to the pollution of that part of Raritan Bay by the sewage from the municipalities described in Exhibit 182, Page- 890, 891, the same being a part of the sanitary inspection made under my general direction by the Division of Sanitary Engineering of the New York State Department of Health in 1908.

Q. You have already testified to your method of procedure in these examinations of water and oyster samples. Did you make any sanitary inspections of the surroundings of the oyster beds on the south shore of Staten Island?

A. One such sanitary inspection was made at my direction and under my supervision by one of my assistants and reported to me under date of Friday, July 1st, 1910. This report also contains the results of the inspection of records of the Metropolitan Sewerage Commission as made by this assistant, at any request, and with the permission of the President of the Commission. This report 3240 of region around about these oysters is presented as a part of my testimony.

Q. Was this an original report?

A. This assistant made weekly reports, but this inspection was the work of that week.

Q. Who were the reports made to?

A. The reports were made to me.

Mr. O'Sullivan: I offer the report produced by this witness and described by him in evidence, being the weekly report of Dr. H. D. Pease, of the Lederle Laboratories on sanitary inspection of the south shore of Staten Island, and ask that it be marked Complainants' Exhibit No. 195.

Cross-examination by Mr. Riker:

Q. Who made this report?

A. Payn B. Barsons.

Q. Where is he?

A. Now?

Q. Is he alive?

A. Yes, as far as I know. He is on the staff of the Metropolitan Sewerage Commission. At that time he was assistant in the Bacteriological Department of the Lederle Laboratories, under my supervision and direction.

Q. Do you know whether he has already been sworn in this case?

A. I cannot say of my own definite knowledge, but I have heard that he was.

Q. Is this report as he presented it to you?

A. Exactly.

Mr. Riker: The report is objected to on the ground that the report, if evidential at all, should be proved by the person who made it, it appearing that he is still in the Land of the Living and can be produced.

The Commissioner: Note the objection of Counsel for defendants. Received and marked Complainants' Exhibit No. 195.

Marked Complainants' Exhibit No. 195.

Direct examination by Mr. O'Sullivan (resumed):

Q. Dr. Pease, I hand you Exhibit- Nos. 188, 189, 190, 191
3241 and 192 and ask you to state what you did in relation to those exhibits prior to today, when they were offered as exhibits?

A. All of the original records giving the information as to the source of the samples and by whom collected, and all of the cards showing the results of the examinations, have been examined by me on several occasions, and the plans for the presentation of this data and the results of the examinations were made by me and the Exhibits were prepared under my direction.

The plans for the preparation of these exhibits were formulated by me and also issued by me to my Assistants who compiled the results of the examinations and the data in our original records in these forms. I have compared the results of a large number of the data charted in these exhibits with the original records. The original records have been examined by me on a large number of occasions in connection with the making of reports of examinations and expressions of opinion to my clients as to the sanitary condition of the oyster grounds from which the samples were examined and the data here charted.

Q. Directing your particular attention to Exhibit No. 191, for B. Coli in the samples of water with the results from the test I ask you what relation exists between the results of the tests applied for B. Coli in the shell fish liquor of oysters?

Mr. Riker: The question is objected to on the ground that it is based on an exhibit which has not been properly proved in the cause.

The Commissioner: Note the objection of Counsel for defendants.

A. A comparison of the results of B. Coli tests on samples of water collected from oyster bed No. 490, Exhibit No. 191 with those made on the shell liquor of oysters collected from the same bed show that with the exception of the period beginning early in November 1811 and extending to the first of May, 1912, in no instance were
3242 larger numbers of B. Coli found in one C. C. samples of the water than were found in similar quantities of the shell liquor of the oysters. This preponderance of positive results of tests for B. Coli in the shell liquor of oysters over the waters surrounding these shellfish, indicates an active condition on the part of the

physiology of the oyster. In the period that I have mentioned, early in November 1911, and extending to May 1912, the results already mentioned do not hold good. The results of the examination of samples of water and samples of oysters as here shown demonstrate that there were larger numbers of B. Coli in the water during the period I have mentioned than in the shell liquor of the oysters. This demonstrates an inactive condition on the part of the oysters, and is due, in my opinion, to the low temperature of the waters in which the oysters are located. This inactive condition of the oysters due to the low temperature of the water I have designated as a hibernation of the oyster. Until I applied this term to this condition of oysters, in May 1910, the fact that oysters hibernated was not known.

I desire to call attention to the fact that the curve of mean temperatures during October, 1911 as shown by the exhibit now under consideration shows for the first twenty two days much higher records than appear in the record submitted by me as Exhibit 193 which shows the daily mean temperatures for October 1904. The results of the tests for B. Coli in water and oysters in the samples collected in October 1911 show upon the chart Exhibit 191 that while the numbers of B. Coli in the shell liquor of the oysters was somewhat larger than the numbers in the samples of water, nevertheless, they tend to approximate each other in October. In the latter part of November, 1911, the results clearly show larger numbers of B. Coli in one c. c. samples of the water than in similar quantities of the shell liquor of the oysters. Given colder weather in October, 3243 1911, the numbers of B. Coli in the water would have been equal to the numbers of B. Coli in the shell liquor of the oysters and the comparison between the numbers of B. Coli in oysters and water would have been identical or more closely resembling those noted in the table on Page 55 of Complainants' Exhibit No. 2.

I desire to point out the following facts demonstrated in the chart which constitutes Exhibit No. 191. First, it should be noted that unusually large numbers of B. coli in the shell liquor of oysters are to be noted in the months of September, 1911, June, July and August 1912. I further point out that the presence of more than 7 B. coli per c. c. in the shell liquor of oysters occurs only in the months of September and October, 1911, and May, June, July and August, 1912. With the exception of the period between December 15th, 1911 and March 28th, 1912, during which no samples of oysters or of water were collected, there appear to be no instances in which samples of oysters show as large a number as 7 B. coli per c. c. of shell liquor.

I direct attention be especially called to the repeated drop in the numbers of B. coli in the shell liquor of oysters in the latter part of October, and the first part of November, 1911, and to the fact that so far as the examinations were made, smaller numbers of colon bacilli per c. c. of shell liquor continued until the following May. The results here shown are not in the least exceptional.

Instances could be multiplied where similar drop took place at approximately the same time in the year 1911 and a similar rise

which took place in the year 1912 in the month of May. In fact the instances in which the drop in the numbers of colon bacilli per c. c. of shell liquor of oysters occurred as the result of the examination of samples made under my direction in the Fall of 1910,

that I felt the necessity of studying the cause of this fall, 3244 and finally came to the conclusion that this repeated decrease in the numbers of colon bacilla in oysters which were taken from waters more or less polluted with sewage was due to a decided biological change in the oysters, and was probably due to the development of a condition of hibernation. The fact that oysters hibernated was not known prior to this time, at least if the phenomenon had been observed by scientists no mention had been made of the same in the literature on the biology of oysters. On May 17th, 1911, at the meeting of The Oyster Growers and Dealers Association of North America I gave expression to my opinion that oysters entered into a true state of hibernation with the advent of a low temperature of the water surrounding them, and that this hibernation continued until the advent of a decidedly increased temperature in the Spring. The study shown in the chart Exhibit No. 191 and made for the purpose of not only adding further confirmation to the observations which had already been made, and in support of the statements which had been previously published, but for the purpose of obtaining more accurate information as to the temperatures of the atmosphere which would tend to bring on hibernation, but also to determine the temperatures of the water which would tend to prolong the period of hibernation or which would cause a cessation of the same. From a study of the details as shown by the data plotted on the chart constituting Exhibit No. 191, I draw the conclusion that *when* the onset of decidedly cold weather in the Fall months, either in the latter part of October or the first or middle of November, with a consequent fall in the temperature of the water in which oysters are located, that the oysters pass into a stage of complete hibernation, which persists as long as the temperature of the water is below 42° F., but with the increase of the temperature above this point, there is a gradual

cessation of hibernation, although there is no evidence that 3245 the oysters resume the activity which they displayed in the previous summer and fall, until the temperature of the water reaches 60° F. In the period in the Spring months, when the temperature of the water is irregularly increasing from 42° F. to 60° F. shown in Exhibit 191, the results of the examinations of the samples of oysters do not show the presence of as large numbers of colon bacilli as did the examination of samples in the month of October when the temperatures of the atmosphere were approximately the same. With the advent, however, of temperatures continuously over 50° F. the results of the examinations of samples of shell liquor of oysters approximate those obtained by the examination of samples in the latter part of September and the first of October, when the temperatures were approximately the same. I draw the conclusion from these facts that with the reduction of temperature in the Fall, the oyster passes first from a stage of a very

active feeding into one of comparative physical inactivity, although until the temperature passes decidedly below 45° F. the oysters do not pass into a state of complete hibernation. In the Spring, with the advent of warmer weather, and an increase in temperature in the water, the oysters proceed more slowly to revive from the state of true hibernation, but do not begin actively feeding until the water has reached 60° F. and remains there. These facts have a most important bearing on the significance of the results of the examinations of samples of oysters for the presence of numbers of colon bacilli in the shell fish. The results of such examinations have been accepted as indicative of the sanitary conditions of oyster grounds, and all the fitness of the oysters for food purposes. I desire to submit the results of recent tests made by me as to the effect of a temperature of 36 degrees upon the exclusion from a sample of oysters in a solution of fushsine of the coloring matter of 3246 that solution from the interior of the oysters. In this report appears the interpretation that as the particles of this dye are indefinitely smaller than the bodies of bacteria, it is a warranted conclusion that such a complete closure of the shell as was here demonstrated, would mean the total exclusion of bacteria from the body of the oyster or its cavities. I submitted a report of experiments made by me under the title "Testing Oysters for the effect of Temperature upon the Active or Aducta Muscle."

Q. Prepared by whom?

A. This experiment was done by me, made by me.

Q. Personally?

A. Yes.

Mr. O'Sullivan: I offer that in evidence and ask that it be marked Complainants' Exhibit No. 196 in evidence.

Mr. Riker: The offer is objected to on the ground that the issue is not whether or not the annual processes of the oyster are properly called hibernation or not, but whether or not the proposed discharge of the Passaic Valley Trunk Sewer will create a nuisance in New York Harbor.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 196.

Marked Complainants' Exhibit No. 196.

Q. Proceed, Doctor, please?

A. I conclude from an examination of Exhibit No. 191 that the oysters grown in the waters of Lower New York Bay in the vicinity of Great Kills undergo complete hibernation beginning in the Fall months and extending until the Spring, and that such complete hibernation excludes the entrance of any sewage pol- 3247 lutted materials even the sewage bacteria from the body or tissues of the oyster.

There can be therefore no menace to health in the consumption of the oysters obtained from these waters during the period of complete hibernation, even if the oysters are eaten in the raw state. However, there is another factor which develops in the oysters in this location at the time of the development of hibernation which practically excludes them from sale upon the market. I refer to

the development of the so-called greening of oysters, which consists in the appearance of a bright green color upon the gills and in the vessels of the body of the oyster.

Q. Dr. Pease, in the course of your investigations and laboratory experiments on the subjects that you have just testified to in relation to oysters have you investigated the subject of the green coloration of oysters?

A. I have been investigating the subject of the green coloration of oysters during the past two years. I have read the literature on the subject thoroughly. It appears from my studies of the literature and from the personal investigations which I have made, that the development of the green color of oysters is an action which occurs during the late fall months. It apparently begins at the time hibernation starts. An exact chronological connection between greening and hibernation has not yet been made out by me, but it is certain that the time of onset of both is approximately the same. The green in oysters appears to persist during the hibernating period, and even for much longer periods. Oysters which have been grown in waters where greening regularly takes place in the fall of every year, have been transplanted to remote oyster grounds in other states where greening has never been known to take place, and yet in the transplanted oysters there have been some which have shown traces of green color for at least two years. As a
3248 general rule, however, the green color leaves the oysters during the succeeding summer after the onset of the greening the previous fall. In the literature there have been numerous descriptions of the green color of oysters being due to the presence of certain low forms of vegetable or animal life, having a green coloration in the food upon which the oysters have been feeding. It is quite possible that this is the case, but I have personally made no observations of green oysters of this type, if they exist. The green oysters investigated by me have shown an accumulation of blood cells on the surface of the gills. These blood cells contain fine, round granules of green color in varying numbers. When the blood cell breaks up by handling, these granules appear in the surrounding liquor. The blood cells in the blood vessels of the oyster likewise contain these green granules. It is quite possible that these blood cells have been mistaken by some observers for low forms of animal or vegetable organisms. In the oysters I have investigated, these cells are clearly demonstrable as blood cells. I have examined a large number of green oysters from Bed 490, off Great Kills, these oysters having been brought to me by Mr. Sanbeg. I desire to submit, as part of my testimony, a report on the investigation of samples of oysters which have been submitted to me, samples were represented as coming from oyster grounds in various parts of this country, Canada and England. The examinations of these oysters were made for the determination of the amount of copper in them.

Q. What part did you direct done in the subject matter of this report, Dr. Pease?

A. I examined a considerable number of the oysters for the presence of the green color. The oysters were then transmitted by

me to the chemist of the Lederle Laboratories, who made examinations as to the amount of copper present in the samples submitted.

3249 Q. Under your direction?

A. Under my direction.

Mr. O'Sullivan: I offer the report just described by this witness in evidence and ask that it be marked Complainants' Exhibit No. 197 in evidence.

Mr. Riker: Has the presence of copper any relation to the pollution of sewage pollution?

The Witness: Not that I have as yet determined.

Mr. Riker: The offer is objected to as being immaterial and irrelevant to the issues in this case.

The Commissioner: Note the objection of Counsel for Defendants. Received and marked Complainants' Exhibit No. 197.

Marked Complainants' Exhibit No. 197.

Q. Dr. Pease is this green colored oyster often mistaken for a polluted oyster?

A. Very frequently.

Q. And is objectionable in the oyster trade, is it?

A. Very objectionable.

Q. What inferences do you draw, Dr. Pease, from this report that has now been marked Complainants' Exhibit No. 197?

Mr. Riker: The question is objected to as irrelevant and immaterial and incompetent, dealing with a matter outside the issues in this case.

The Commissioner: Note the objection of Counsel for Defendants.

A. The conclusions which I wish to make from a study of this report are as follows: That oysters containing green coloration show a greater amount of copper than normal colored oysters obtained from the same location:—that normal colored oysters are frequently obtained which show much larger amounts of copper than green oysters from other locations. There is no direct relation between

3250 amounts of copper present and green color, other than stated in my first conclusion. Copper appears to be present in oysters without producing green color, for in fact, all oysters examined under my direction have contained traces of copper. The presence of the green color in certain oysters appears, therefore, to be associated with the presence of copper in some unusual form or combination. It is well known that copper can exist in combination with cellulose, which is the common ingredient in vegetable organic matter, but this combination takes place most readily when the copper is in the form of cuprammonium. The presence of copper and free ammonia with cellulose can result in the combination of the same, even at low temperatures. The cuprammonium cellulose is however, a loose combination between the respective chemical elements and can be readily broken up by great dilution. If such a combination gained access to the food of oysters and was taken in by them the organic elements would doubtless be digested

by the oyster, leaving the metallic compound not absorbed, or, if they were, absorbed into the digestive tract of the oyster, it would be necessary for the oyster to eliminate the same. The eliminating apparatus of the oyster is not thoroughly understood. It is known, however, that the oyster has no kidney and it is altogether probable that the breathing apparatus of the oyster serves the purpose of a kidney. In any event, we find the blood cells of the oyster carrying the green pigment, which is, in my opinion, basic copper chloride, and it is further my opinion that the oysters are attempting to eliminate this metallic element from their tissues when the larger number of blood cells containing this pigment are found upon the surface of the gills of the oysters. Another possible interpretation, but one which does not appeal to me strongly is that the green pigment is present upon the surface of the gills of the oysters and that the

blood cells have passed out of the blood vessels and have engulfed the same, a certain number of them passed back into the blood vessels and there attempted to destroy this pigment.

In either case, it must be assumed that the pigment appears in the oysters as the result of the feeding or drinking of the shellfish, upon food containing copper in combination with it, for if the copper was merely held in solution or in suspension in the sea water, it would undoubtedly pass through the gill cavities without exerting any effect upon the same, in the same way that sand and particles of inert substances pass through these same cavities. I have already stated that copper, free ammonia and cellulose, when brought in intimate contact, can result in the formation of a double celloid salt of cellulose at temperatures of sea-water in the summer or fall seasons. The conditions, therefore, under which this combination takes place are those which very commonly exist in the late summer and fall on some oyster grounds. In oyster grounds which are polluted with sewage, there are to be found in all instances varying amounts of free ammonia. When, however, sewage deposits exist in considerable amounts on the bottoms of tidal waters, these deposits commonly undergo anaerobic decomposition with the production of free ammonia and other products of decomposition. The ammonia produced by such anaerobic decomposition would be readily available for combination with all forms of organic matter and copper for the production of cuprammonium cellulose or copper proteids. I desire to state here that all sea water contains copper in varying amounts in different locations. If this combination took place and the same was taken up by the oysters lying on the surfaces of such deposits or in close proximity to the same, the conditions would be ideal for the production of the green color in the oysters. However, such conditions of anaerobic decomposition are undoubtedly present in the warmer seasons of the year before the de-

velopment of green color is generally noted, and it is altogether possible for oysters to consume during these months, particularly August and September, these copper-containing foods without the appearance of green color. For example, it would be entirely possible for an oyster in the state of full physiological activity, to thoroughly digest the organic elements of such food and

excrete the metallic compounds as well. When, however, the sea water becomes colder in the later fall months, the activity of the oyster is restricted, and while it might be entirely possible for the oyster to digest the readily assimilable organic elements of copper-containing foods, it might experience considerable difficulty in excreting copper compounds which had been associated with such foods. The result in such an instance, would be accumulation of such copper compounds and the development of the green color would be the logical result. I conclude the presence of the green color of oysters is due to the consumption by the oyster of organic food substances containing in loose combination, copper compounds, and that at the time of the development of the green color, the oyster, while able to digest and assimilate the organic elements in these foods, is unable to sufficiently excrete the copper compounds, and that the same accumulate in the oyster and that the green color of the gills is due to the effort on the part of the oyster to eliminate these copper compounds through the action of the extrusion of large numbers of blood cells, containing the copper pigments, out into the gill cavities. It is further my opinion that these copper cellulose and proteid compounds are formed as the result of anaerobic decomposition of organic materials, either on or in location adjacent to such oyster beds. Whether or not the copper must be present in the sea water or in the sludge deposits on tidal bottoms in some particular form other than as the copper may exist

3253 normally in sea water, has not as yet been determined by me. It is entirely possible that the copper exists in sea water or in such sludge deposits in some special form and that it gains access to these deposits from trade wastes which may form a constituent part of the sewage from some municipalities or industrial establishments, but as I have already stated, I have not as yet been able to determine that the copper must exist in these special forms as trade wastes.

Q. Dr. Pease, does the question of the pollution of oysters, so far as the oysters of New York Bay are concerned, relate to the use of these oysters during the non-hibernating period of the year?

A. It does.

Q. Now, what significance have the results of your examinations of the samples of oysters as contained in the exhibits that have just been submitted in relation to the use of oysters for food in the raw state?

A. I have already expressed the opinion that the results of the examinations of samples of oysters as they appear in the table on Page 55, Complainants' Exhibit No. 2, show that the oysters were in a condition of complete inactivity and that the numbers of *B. coli* were correspondingly low. As *this was* the only available results of examinations made prior to 1908, a comparison of these with those made in 1908, 1910, 1911 and 1912, would hardly be warranted, unless the comparisons were confined to months showing similar conditions of temperature.

I have already presented the results of the examinations of oysters which were made under my direction in the months of August and

September, 1908, showing the results of the examinations of oysters collected from certain beds in the same general geographical group which have been presented as exhibits.

3254 Q. Dr. Pease, directing your attention to Exhibit No. 192, I ask you what relation exists between the number of colon bacilli found at present during corresponding periods in the beds grouped under the four heads as shown by the different colors in this exhibit?

A. Excluding the results which appear in exhibit No. 192, which were obtained from samples collected during the hibernating period, namely, those collected after November 4th, 1911, it can be said that on the whole, the results of examinations in the months of August and September, 1910, and in the same months in 1911, and those in 1912 during the same period, that during the last three years somewhat higher *B. coli* scores, or numbers of *B. coli*, have been found in the shell liquor of oysters than were determined to be present in the examinations made in 1908. However, these increases are in part due to particularly high scores obtained in one or two instances, whereas the average of the scores made after eliminating these particular instances, show approximately the same numbers of colon bacilli as were found in 1908. Whether the greater frequency of these unusually high scores in the last three years indicate a greater degree of sewage pollution of the waters of these regions, cannot be stated positively, but it is suggested.

Continuing my discussion of Exhibit No. 192, I would say that in general the results are similar to those already discussed in the consideration of the investigation made in 1908. There appears to be no one of these groups which shows constantly a larger number of colon bacilli in the shell liquor of the oysters than are found in the same material from samples from the other groups of beds. In fact, I desire to express the opinion that the distribution of such pollution as exists in the waters of the oyster beds of this region, as shown by the results of the examination of the
3255 oysters during the non-hibernating period of the years 1908, 1910, 1911, appears to be remarkably uniform. For this reason, it is warranted to assume that such pollution as has gained access to these waters is distributed in them with a reasonable degree of uniformity. This, in turn, warrants the conclusion that the polluted materials do not gain direct access to these waters from any particular sources of minor pollution, but that there is some large source of pollution which permits of an even distribution of the polluting materials in the waters over this extensive area.

In my studies on the sanitary conditions of oysters in other large bodies of water, such uniformity of distribution of pollution has not been noted. Since my investigations of all kinds in 1908, I am of the opinion that the main source of the pollution of the oyster beds which are off Great Kills and in the vicinity of the the oyster beds as shown in Exhibit 192 in which there appear the arrangement of some of these beds in three groups, come into the waters of the lower Bay through the Narrows, and that this pollu-

tion finds its way, in large part at least, in an indirect manner to the oyster beds in question.

I have frequently expressed the opinion that the oyster beds off Great Kills in the lower New York Bay were safe for consumption even in the raw state, when removed from the beds during the non-hibernating period of the year; but that if any substantial increase in the pollution of the waters passing over these beds should occur, that the oysters in the non-hibernating period of the year would then contain such numbers of colon bacilli as would make their shipment in Interstate Commerce illegal on account of the action which has been taken in the past by the officials of the U. S. Government connected with the enforcement of the Pure Food Law.

3256 Q. What is the effect of sewage pollution on oysters in your experience?

A. The effect of sewage pollution on oysters is to increase the numbers of B. coli to be found in the shell fish liquor of the oysters during the non-hibernating period of the year.

Q. And as to oysters as a food supply, what effect does it have?

A. You mean sewage pollution?

Q. Yes.

A. Sewage pollution of oysters, if carried to a great extent, or if the amount of pollution is great, or if the amount of pollution is small, but the pollution is very direct in its character, tends to make oysters unfit for consumption in the raw state during the non-hibernating period of the year.

Will screening and sedimentation remove the unjurious elements from the sewage so that the oysters will not be affected thereby?

A. I do not desire to qualify as a sanitary expert, but as B. coli have been found by me in a large number of instances in sewage, which has been treated in this manner, the effluent from plants so treating the sewage have polluted the waters around oyster beds, the B. coli having been found in large numbers in such oysters.

Q. From your knowledge and experience of the conditions of the oyster beds in the Lower Bay, would further pollution tend to destroy these oyster beds, if appearing in increased quantity?

A. An increased pollution of the waters of Great Kills with the appearance of persistently larger numbers of B. coli in the oysters removed from those beds, would lead me to advise my clients who control those beds to abandon the use of the same for marketing oysters.

Mr. O'Sullivan: Your witness, Mr. Riker.

3257 Cross-examination by Mr. Riker:

Q. What stage of pollution in your judgment renders the oyster unfit for human consumption in the raw state?

A. That is impossible to answer as a general matter. Each instance has to be considered by itself.

Q. Does the presence of one typhoid germ in an oyster bed suffice to render them unfit for human consumption?

A. The presence of one typhoid bacillus in the oyster would indi-

cate the possibility of much larger numbers of typhoid bacilli being in the adjoining oysters.

Q. I was talking of that one oyster, if there was one typhoid bacillus in that oyster, in your judgment is it safe to eat, even in the raw state?

A. No.

Q. Have you determined in your tests the presence of the typhoid bacillus as distinguished from the colon bacillus?

A. I have not.

Q. Who is it that you are advising as you clients?

A. I have several clients who own and control beds in that region.

Q. Are they raising and marketing oysters from those beds?

A. They are.

Q. That is their business?

A. That is.

Q. And you have advised them that while the oysters are approaching the point where they should not be sold, they may still go on and sell them?

A. I have.

Mr. Riker: That is all.

Mr. O'Sullivan: That is all.

AZEL F. MERRELL a witness called on behalf of Complainants, being first duly sworn, testified as followd:

Direct examination by Mr. O'Sullivan:

Q. Your full name?

A. Azel F. Merrell.

3258 Q. Where do you reside?

A. I live at Mariners Harbor, Staten Island.

Q. What business are you in, Mr. Merrell?

A. Wholesale oyster business.

Q. How long have you been in the business?

A. All my life.

Q. Where did you begin in the oyster business?

A. I began first to cull seed oysters.

Q. Where?

A. Staten Island Sound.

Q. Known now as the Arthur Kill?

A. Yes, sir.

Q. Just tell what you know about the oyster business?

A. Why, at that time the northern part of Staten Island and the western part was a gold mine for the people who lived on that side of the Island. They made their living by catching seed oysters and those far enough advanced, they took them to Princess Bay and planted them. At the end of three or four years, as the case might be, they began to take these oysters up from Princess Bay and sold them, marketed them. Some, who were not so fortunate, sold them, sold all they caught to the dealers who did business and planted them for their own account.

Mr. Riker: I shall have to move to strike this testimony out as entirely incompetent. It is not introductory, and it is cumbering the record with matter that is incompetent and irrelevant.

The Commissioner: Note the motion of Counsel for Defendants.

Q. Are you connected with any large body of oyster growers?

A. Yes, I have been President of the Oyster Growers and Dealers Association of North America.

Q. How long have you said that you were in the oyster business on the Staten Island shore?

A. All my life.

Q. Give us some idea in years, Mr. Merrell?

3259 A. Well, I began possibly at the age of 15 or 16 years.

Q. 20 years, 30 years?

A. Yes, sir, more than that.

Q. Now, do you know anything about the oyster beds in the neighborhood of Princess Bay?

A. Yes, we have considerable beds down there.

Q. I show you Complainants' Exhibit No. 181. When first you went into the oyster business, Mr. Merrell where were the great seed oyster areas?

A. All along this Kill van Kull and on the north side of Staten Island, and down the Arthur Kill. We called it then the Staten Island Sound. They were very prolific natural oyster beds. There was nothing taken from those waters for food—it was all seed land.

Q. Were there any beds in the Upper New York Bay when you first went into the business?

A. Yes, sir.

Q. Extensive beds?

A. Quite extensive, yes, sir.

Q. Were they marketed?

A. Yes, they were taken directly from those beds and sold in the markets of New York.

Q. Where do the oyster beds lie. Will you indicate on Complainants' Exhibit No. 181 the areas covered by the oyster beds?

A. Along the shore on this map, New York Bay, but the food beds were down here in Raritan Bay, beginning at Tottenville and going down as far perhaps as nearly to Great Kills Bar. The Bar at that time was not used. Along to the west of that Bar.

Q. What oyster grounds are now left on the Staten Island shore?

A. Very few, just a little trace of lanes right here from the east of the old orchard shoal buoy to the Elm Tree light and from there a strip out towards the ocean.

Q. Are there any west of that line?

A. What was once the best of the oyster lanes was west of that point.

Q. What condition are these earlier oyster lanes in now?

3260 A. They do not use them now at all.

Q. Are they abandoned?

A. They have been abandoned, yes, sir.

Q. Do you mean the ones east or the ones west?

A. I meant the ones west, between the mouth of the Arthur Kill and Great Kill Bar, all along the south shore of Staten Island.

Q. Why were they abandoned?

A. Because they were told that the oysters produced by them were not fit for food and the oyster men themselves were not anxious to sell something that was not good and they had to abandon them. They could not use the ground for the raising of oysters.

Q. Where did the sewage come from that destroyed the usefulness of these beds?

A. The sewage that destroyed these beds came down the Arthur Kill and the Raritan River.

Q. Did you see any indications of that sewage other than the destruction of these oyster beds?

A. The only other indication I saw was on the sides of vessels or boats.

Q. What would it do to the boats?

A. Any light colored paint it would discolor it over night. If it was damp, foggy weather, in the morning—the gases rising would discolor the paint.

Q. Was that in the Arthur Kill?

A. Yes, in the Arthur Kill and the upper part of the Lower Bay.

Q. What discoloration would take place, would it be black?

A. Yes, a very dark color, dark green.

Q. Would it be any other color beside dark green?

A. No, just a dark sickening green color.

Q. A very dark green?

A. Very dark.

Q. Was it almost black?

A. Yes, quite black.

Q. Did you see any other indications of the sewage there on piles or spiles or posts?

3261 A. Yes, all along the western shore of Staten Island, there is marsh land, more or less, and when the tide rises and falls and leaves a deposit on the edge of the meadows, on this salt grass, it destroys it completely. It is so dark that anyone who goes down there can see the discoloration, and on the side of the meadows, the banks, it is slimy and disgusting.

Q. Have the number of men engaged in the oyster industry along Staten Island shore decreased?

A. Oh, indeed they have almost all left the business and gone into something else. There are very few of the older oyster men who used to make their living from seed bed and oysters, they have gone somewhere else.

Q. Were there many of them?

A. Why, yes, sir, almost the entire population of the west side of Staten Island was composed of oyster men who made their living entirely by working on seed lands or being employed by others who hired them for work in the Lower Bay.

Q. Were there thousands of them?

A. Yes, sir.

Q. Give me some idea of the number?

A. I should say that a very conservative estimate of that number would be five thousand.

Q. They have disappeared from the business.

Mr. Riker: When is this witness talking of now?

The Witness: Of a period of about twenty years ago to fifteen years ago.

Mr. Riker: I move that this testimony be stricken out as irrelevant and incompetent. It is within twenty years of the period involved in this suit.

The Commissioner: Note the motion of Counsel for the defendants.

Q. How many are engaged now on the Staten Island 3262 shore in the oyster industry?

A. Practically none.

Q. Are those beds regularly examined now to determine the fitness of the oysters for food??

A. The beds have not been examined very recently, because they are supposed to be unfit for use, but the beds are being tested annually or more than that, several times a year on the borders of where the polluted areas may be and the areas from which they are taken for food.

Q. You are talking now of present conditions?

A. The present conditions of today. Even while we are speaking we have oysters being analyzed at the laboratory for that purpose, to know whether they are fit for food or not.

Q. What laboratory and who, if you know, makes these examinations?

A. The first investigation we had was by Professor Higby of the Brooklyn Research Laboratory and they are being conducted now by the Lederle Laboratories.

Q. Is anybody in particular there conducting these examinations?

A. I really do not know who conducts them. We send them in for analysis and they send us back the report.

Q. Who signs the report that you receive?

A. Dr. Pease generally.

Q. Are the oyster areas that are left now large or small?

A. Very small. There is just that small strip east of the Great Kills Bar extending toward Elm Tree Light and out toward the ocean. Some parts of the Bar being used, not a great deal.

Q. Are those oysters taken from there used in interstate commerce?

A. Yes, sir.

Q. Have you had any difficulty with the Pure Food Law in relation to them?

A. No, only we are under their supervision. They examine the oysters as they are taken from us. We have had them examined on the Pacific Coast several times and in the western states.

3263 Q. Have inspectors from the Agricultural Department visited your plants?

A. Yes, sir.

Q. And made examinations of your oysters?

A. Yes, sir.

Q. Did you ever receive any notice of condemnation of your oysters?

A. Not ours, no, sir, but some of our neighbors have.

Q. What do you think would be the effect on your oysters of an added amount of sewage?

Mr. Riker: The question is objected to on the ground that this witness is not competent to answer it.

The Commissioner: Note the objection of Counsel for Defendants.

A. The effect would be that it would wipe out the business to my mind.

Q. Are you familiar with the currents and their effect on the sewage coming on the ebb tide?

A. Why, somewhat.

Q. When you first went into the oyster business was New York Upper Bay noted for its fish, other than shell fish?

A. Oh, yes, for the shad fisheries particularly, and striped bass and other fish of that kind.

Q. How is it now?

A. Well, you would not want to eat them. They are not caught scarcely.

Q. Did the sewage pollution that you speak of interfere with the ship building yards?

A. Yes, indeed.

Q. In what way?

A. There was a time when the ship building yards of Staten Island were employed almost entirely to build and renew old oyster boats. There was quite an industry on the north and west shores, and now nothing of that kind is being done, no new boats are being built, and very few are being repaired.

Q. Do you know whether or not it is the coarse sewage that floats on top of the water, or the finer sewage in solution that injures you oysters most?

A. Our experience has been that the finer material mixed with the water is what does the injury. Not the coarser stuff that floats on the surface, but our trouble has been with that which mixes with the water.

Cross-examination by Mr. Riker:

Q. Is the oyster propagated in the water or on the land under the water?

A. Well, they are certainly propagated on the land under the water.

Q. So that they would not be affected by water that happened to be on the top?

A. Certainly not.

Q. Are you interested in this company that is raising, gathering and marketing oysters off the Great Kills?

A. What company do you refer to?

Q. Any company.

A. Yes.

Q. Financially interested?

A. Yes.

Q. Is the land surrounding Great Kills populous?

A. Yes, sir.

Q. Are there sewers discharging into it?

A. No, sir, not very much. There are no sewers emptying into the water adjoining the Great Kills inlet or the Bar.

Q. You know that, do you?

A. I certainly do.

Q. Where is the nearest sewer?

A. The nearest sewer is the Staten Island Sound, the Arthur Kill. There is nothing discharging upon the lower side.

Q. Are there any oysters raised to your knowledge within a considerable distance of any sewer outlets?

A. No, there are no oysters raised for food that are near a sewer.

Q. The polluted area that you have been talking about, is it contaminated in your observation by the direct discharges of sewage into the waters?

A. Yes, from the Staten Island Sound waters or the Arthur Kill waters, and that which may come down the Narrows.

3265 Q. And it is only this little section on the Great Kills where there is no direct local sewage contamination which is now being used for propagating oysters?

A. There is no sewage emptying into the Bay outside of the Arthur Kill and the Narrows, nothing emptying into the Bay on the south side of the Island.

Q. It is along the south side of Staten Island where the oysters are now being propagated exclusively?

A. Yes.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. How many acres in that area are now being cultivated, about? I want to get some idea of the area?

A. I should judge about 2,000 somewhere about that, and there has been more than twice that abandoned.

Q. And what would be the number of bushels marketed from that area in one season?

A. That is a question that would be——

Q. Approximately?

A. Why, possibly a half million bushels.

Q. Has the oyster business been steadily decreasing since your connection with it?

A. Yes, sir, steadily decreasing in Princess Bay and increasing among the Eastern people. That is the business in New York has not got less, but the oysters are being brought from Eastern points

to the New York markets, so New York has lost the market of its own product.

Q. Mr. Riker asked you if the water above the oyster affected it. What do you think?

Mr. Riker: He answered it. The question is objected to on the ground that the witness has already answered the question.

The Commissioner: Note the objection of Counsel for Defendants.

A. He asked the question whether the sewage mixed with the water was most injurious or that floating on the top. I said that the sewage mixed with the water that came in contact with the
3266 oyster direct would be the most injurious.

Mr. O'Sullivan: That is all.

Adjourned to September 18th, 1912 at 10:30 A. M.

3267 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against

STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, Sept. 18, 1912—10:30 o'clock a. m.

Before James D. Maher, Esq., Commissioner.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

WILLIAM T. SEDGWICK, a witness called on behalf of Complainants, and being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Your full name?

A. William T. Sedgwick.

Q. Are you connected with any professional institution?

A. My principal position is that of Professor of Biology and Public Health in the Massachusetts Institute of Technology.

Q. Where did you graduate in Biology?

A. I graduated in Biology at Yale University with the degree of Bachelor of Philosophy 1877; studied Yale Medical School
3268 1877-79. Became Instructor in Physiology Chemistry Yale Scientific School 1878-79. Fellow in Biology Johns Hopkins

University 1879-80. Instructor in Biology at the same 1881-83. Doctor of Philosophy in Biology of Johns Hopkins University 1881. Assistant Professor, Associate Professor, Professor and Lecturer on Sanitary Science and Public Health 1883-1910 Massachusetts Institute of Technology. Professor of Biology and Public Health and Head of the Department, Massachusetts Institute of Technology, since 1910. For eight years Biologist of the State Board of Health of Massachusetts. Have been director of the Sanitary Research Laboratory and Sewage Experiment Station, Massachusetts Institute of Technology since 1902.

Q. Are you the author of any works, Professor Sedgwick, in relation to the subjects that you have been identified with?

A. I am the author of works on "General Biology", "Sanitary Science and Public Health" and "Physiology and Hygiene" and of many special papers upon water supply, sewage purification, epidemiology and other aspects of public health science and practice.

Q. Have you been a lecturer on any of these sciences?

A. I have been and am now lecturer on Sanitary Science and Public Health in Simmons College. I hold the honorary degree Doctor of Science Yale University. I am a member of the Advisory Board, Hygienic Laboratory, U. S. Public Health Service. Member and Past-President, Society of American Bacteriologists, American Society of Naturalists, and New England Water Works Association. Member Board of Directors National Association for the study and Prevention of Tuberculosis. Member American Public Health Association. Fellow American Academy of Arts and Sciences, American Philosophical Society of Philadelphia, and other scientific bodies.

3269 —. Are you familiar with the condition of the waters of New York Harbor and its tributaries and if so state to what extent?

A. I am fairly familiar with the waters of New York Harbor and their condition, and of the waters of the tributaries, having for a good many years passed over some of them from time to time, and having, on behalf of this case and for other purposes, made special excursions through the East River, parts of the North River, and towards Sandy Hook and through the Kill Van Kull and Newark Bay to Newark. I have also known the Passaic River to some extent for a good many years having been called to that vicinity in connection with my professional work, so that I think I may say that I am fairly well informed as to the visible condition of the waters of New York Harbor and its tributaries, although I have not myself made bacteriological or chemical examinations of these waters.

Q. Have you examined the Bill of Complaint, the answer and other pleadings in this suit of the People of the State of New York, Complainants, against, the State of New Jersey and Passaic Valley Sewerage Commissioners, defendants?

A. I have.

Q. I direct your attention to the statements made in paragraphs 12, 14 and 15 of the answer filed by the defendants in this suit and to those portions of these paragraphs relating to the effluent proposed

to be discharged from the Passaic Valley trunk sewer outfall, and to those statements relative to the present discharge of sewage into the Passaic River and from thence into New York upper bay, and ask you, as an expert in public health matters and as an authority upon sewage disposal, whether the statements in these paragraphs are reliable or inaccurate?

3270 Mr. Riker: The question is objected to on the ground that the reliability or the accuracy of the statement is not material to the issue.

The Commissioner: Note the objection of Counsel for Defendants.

Q. You may proceed, Professor?

A. The defendants in their answer assert (paragraph 12) that it "is intended to discharge the effluent" at such a place and in such a manner as to "thoroughly assimilate and diffuse it without serious or offensive pollution, and without increasing the present pollution of the bay of New York." But it is manifest that whatever their intention may be, the effect would inevitably be to materially increase the present pollution of the bay of New York. It is proposed to pour into the Bay of New York the screened and settled sewage of a very large population, amounting in the future to some 360 million gallons in round numbers, more or less, per day, and even if this were considerably purified, it could not fail to produce a material increase in the present pollution of the Bay of New York. Defendants further assert in paragraph 14 of their answer "that all or nearly all of the sewage or other polluting matter which is discharged into the Passaic River directly or indirectly below the Great Falls in the said city of Paterson now passes down through the said river and then into the Newark Bay, and finally reaches and is discharged into the waters of the Bay of New York at or near Robbins Reef Light without any appreciable injury to such waters, and without causing any nuisance."

This statement while plausible is absolutely contrary to fact for it is not true that the sewage and polluting matter discharged as described now passes down through the Passaic River, thence
3271 into Newark Bay, and finally into the waters of the bay of New York. If it did so there would be no nuisance in the Passaic and no need for the expenditure of the vast sum contemplated by the Passaic Valley Commission. On the contrary the facts are that the polluting matter here described is, for the most part, retained within the Passaic River where it produces the nuisance which it is designed to abate and does not even reach Newark Bay itself, still less the Kill van Kull or New York Bay. It is for this reason, in fact, that a nuisance exists within the Passaic river, and it would be much nearer the truth to state that the sewage and other polluting material referred to is now retained within that river and there partially but insufficiently purified. The Passaic River is in effect an elongated septic tank or sewage purification plant, the effluent from which is emptied first into the Newark Bay, where it is further purified and largely diluted, and from which it eventually, thus

purified and diluted, finds its way into the Kill van Kull, and thence, after still further dilution and purification, into New York Bay itself.

Again it is not true that the sewage and other polluting materials referred to in paragraph 14 are "carried slowly backward and forward by the action of the tides." On the contrary a very large amount of the polluting material is now simply deposited upon the Passaic River, where it remains to ferment and putrefy as if in a kind of cesspool; so that only the supernatant and more fluid portions which lie nearest the purifying atmospheric air are moved up and down the Passaic and finally out into Newark Bay, the Kill van Kull and New York Bay.

It is impossible to emphasize too greatly this important and remarkable purifying action, abundant evidence of which is to
3272 be found in the comparatively pure and wholesome condition of the lower reaches of the Newark Bay through which the effluent from this river cesspool necessarily flows.

Again defendants, in paragraph 15, assert that "the waters of the said Newark Bay which cover a considerable area of land are shallow and do not rapidly take up and assimilate the sewage discharged therein."

This statement is a pure assertion, incapable of exact proof without long and elaborate investigations. But so far as any one can judge from observation upon similar bodies of water, and so far as any one can assert, from what is known of sewage disposal and sewage purification, the statement is absolutely erroneous; for it would be difficult to imagine a body of water better calculated to "rapidly take up and assimilate" sewage. It is, in the first place, sluggish and comparatively shallow. Now sluggishness favors sedimentation, and sedimentation is one important element in sewage disposal and sewage purification. It is also shallow, and shallowness greatly favors the enrichment with oxygen, the indispensable element in sewage purification owing to the penetration of the atmosphere to considerable depths under the influence of winds which readily disturb shallow bodies of water, but affect deep bodies only with difficulty. Again, shallowness is highly favorable for the warming of water, and warmth is an indispensable element of sewage purification. Finally shallowness favors the germicidal action of sunlight, and thereby tends to the destruction of disease germs.

In short, the greater part of paragraphs 14 and 15 of the defendants' answer are, in my opinion, erroneous and misleading.

Q. Have you examined Paragraph 21 of the Answer of
3273 the Defendants, and, if so, will you state whether from the sanitary point of view the waters of the Bay of New York and the waters of Newark Bay intermingling together form one bay or harbor?

A. I have examined the paragraph referred to and I can say that whatever the facts of engineering topography may or may not be, it is not true from the sanitary standpoint that the waters of New York Bay and of Newark Bay form one bay or harbor. On the contrary, each has its own sanitary conditions which affects in its own peculiar way whatever sewage may be deposited within it, and

it would be difficult to find two bodies of water more unlike in their capacity for receiving and discharging sewage than these two bays, one of which is practically an extension of a great tidal river, the other a wide, shallow secluded, landlocked estuary into which the Passaic and the Hackensack Rivers, small and comparatively unimportant streams, pour a limited volume of water.

Q. Speaking as a sanitarian, are you familiar with water sheds, water courses and streams used for sewage disposal and if so state whether or not you consider the proposed place of discharge in New York Bay, that is the proposed discharge near Robbins Reef from the Passaic Valley Trunk Sewer outfall to lie, from the sanitary point of view, within or without the natural drainage area of the Passaic River or valley?

A. I am familiar with watersheds, water courses, lakes, estuaries, and the like as places of sewage disposal and with the natural behavior of sewage, drainage and other polluting materials flowing from watersheds into such streams, lakes, estuaries, and in my opinion the direct conveyance of the merely screened settled sewage of the Passaic Valley as proposed by a closed pipe tunnel or conduit to the place of the proposed discharge at Robbins Reef is in effect to remove such sewage from its natural watershed and drainage area upon which it now undergoes extensive purification and to deposit it undefecated and putrefying and without natural or adequate opportunity for self purification within the confines of a separate sanitary watershed. In short, from the sanitary standpoint, I do not consider the towns and cities on the Passaic Valley are "riparian" to the waters of New York Bay.

Q. Have you considered from the sanitary point of view the proposed point of discharge of the Passaic Valley Sewer?

Mr. Riker: I object to the question as to its form. It is too general.

The Commissioner: Note the objection of Counsel for Defendants.

A. I have; and in examining any coast survey chart which shows the bottom of the bays and harbors and also the location of the line which separates the State of New York from the State of New Jersey I have been struck with the fact that the outlet proposed is apparently placed just as near the edge of the territory of New Jersey as it possibly could be placed. Indeed, in view of the location proposed, namely, at a remote corner or angle of the territory belonging to the State of New Jersey, I cannot avoid the suspicion that this particularly remote corner was selected for the reason that whatever damage might arise would affect the people of the State of New Jersey comparatively slightly.

Q. Professor will you state whether or not you consider the proposed discharge of sewage near Robbins Reef objectionable and contrary to the public health, interest and welfare?

Mr. Riker: The same objection.

3275 The Commissioner: Note the objection of Counsel for Defendants.

A. I do consider the proposed discharge highly objectionable and contrary to the public health, interest and welfare because, in the first place, such a system of disposal runs counter to the spirit of modern sanitary science, since it proposes to foul still further a body of water already too much polluted, and thus violates the first principle of public health conservation, namely, cleanliness. It is now held by all advanced and highly civilized people that cleanliness is one of the first requirements of a healthful environment, and the purification rather than the increased pollution of rivers, harbors, and estuaries is a watchword of the time. In my opinion it would be an appalling misfortune if the States of New York and New Jersey should go on much longer adding to the vast burden of filth now placed upon the bays and rivers of the Metropolitan District. These bays and rivers ought rather to be reserved forever for the comfort, convenience, and business and pleasure purposes of the people. It is a recognized fact of sanitary science that a dirty and especially a sewage polluted environment is prejudicial to the public health, so that it is not only a disgusting but a dangerous condition when Manhattan Island or Staten Island or Coney Island is in fact, as has often been said, "a body, of land surrounded by sewage." The disgust comes from disagreeable and filthy appearance in the water, and I may add from foul smells when these exist. The danger — in the fouling of the air supply among other things for air tainted with the gas of putrefaction is unwholesome air.

3276 Danger comes also in bathing, in fishing, in boating, in commerce; as, for example, in the washing of decks, the handling of wet ropes previously dragged through sewage-laden waters; in spray blown upon the faces, hands, clothing, or material handled; in fishing from the handling of wet fish, and the like; in oyster culture and in the consumption of raw shell fish, such as mussels or snails—food frequently eaten by our domestic and foreign population.

The question of air deterioration is by no means merely academic, for the crowded recreation piers, the crowded excursion steamers, and the crowded shores or bathing beaches, wharves, and other places contiguous to the harbor waters testify to the resort thither of hundreds of thousands of the population, every one of whom normally breathes into his lungs a considerable portion of the surrounding atmosphere eighteen times a minute. This condition is real and not imaginary, any one can testify to it who will take the trouble to enter New York Bay or its contiguous waters directly from the open sea or Long Island Sound, or from a visit to the country when the contamination of the air by sewage gases can often readily be detected.

The Metropolitan area of New York and New Jersey is already a vast human ant-hill teeming with one of the greatest commercial and industrial populations on the face of the globe. The health, comfort and convenience of this huge mass of human beings requires that every practical and reasonable sanitary safeguard shall be thrown around it. Vast sums have already been appropriated for its safe and proper water supplies and much greater sums will

3277 be soon required to prevent its bays and rivers from becoming putrefying, nauseating, and dangerous bodies of sewage.

It is fortunate that so little trouble has arisen thus far, but there will surely come a time, probably during some prolonged hot dry spell of summer weather when the comparatively innocuous fermentations which now go on in these bodies of water in the presence of dissolved oxygen will, in the absence of such oxygen, pass over into evil-smelling, unsightly, disgusting, and dangerous putrefactions, with the result that what is now a comparatively decent and unobjectionable body of water will become a public nuisance and cry loudly for relief. Moreover, when that time comes relief will be difficult to obtain, because the gradual accumulations of years such as are going on today will constitute a mass of filth so great as to be impossible to deal with rapidly or to make wholesome quickly.

Instead therefore of adding to the already too extensive pollutions of New York Bay the State of New Jersey ought in my opinion rather to join hands with the State of New York and set to work immediately to prevent all further pollution to the end that these precious bodies of water shall be reserved forever for the real comfort, safety, convenience, and sanitary welfare of the vast populations which will soon surround them.

I believe that the port and harbor of New York are the most important port and the greatest harbor of the country, and a great center of commerce; many foreign and other steamship lines bring and carry unlimited numbers of passengers; its exports, imports, traffic, and trade, foreign and coastwise, are of the greatest volume and magnitude. The United States government has expended 3278 and is expending great sums of money in improvements in and about the harbor, and in dredging channels in the interest of general commerce and for the benefit of navigation and the general welfare of the country. In and about the harbor it has erected, and is still erecting at vast expense, important structures, and it is the owner of a very large amount of public property, including forts, immigrant stations, barracks, dwellings, and the like, and these forts, stations, and buildings are occupied by many officers, soldiers, sailors and employees of the United States and their families, requiring sanitary protection and other comforts and conveniences.

Now the effluent discharged from the dispersions area of the Passaic Valley sewer will in my opinion generally be of a higher temperature than that of the water of the bay in the immediate vicinity, and will, therefore, and for other reasons tend to rise and spread out over the surface, making a polluted, evil smelling, foul, and unsightly surface, rendering life uncomfortable and unpleasant to those living in its near vicinity or passing over it while engaged in commerce, travel and pleasure, and will constitute a nuisance, to the detriment and injury of commerce, navigation, and the public health, comfort and convenience.

I believe that the construction and operation of the proposed Passaic Valley sewer will discharge large quantities of putrid matter

into the waters of New York harbor, which matter will oscillate back and forth through the Narrows and through the channels of both upper and lower New York bays, and will tend in part to settle, make deposits and eventually shoal and obstruct navigation in those waters clogging the navigable channels and necessitating the expenditure of further sums of money in maintaining those channels, for example, by the maintenance of dredges, scows and boats to remove said deposits, while the dredges, scows, and boats thus required will in themselves obstruct navigation, impede commerce, and diminish the comfort, pleasure and convenience of the people of the State of New York. I am of the opinion that all this will tend to make the port of New York less serviceable for commerce and less agreeable and comfortable to the people by virtue, among other things, of the offensive and unpleasant odor and the unsightly appearance of the water, and of the channels, wharves and docks, which will result from the discharge of the sewage in the manner proposed, and by reason of the action of the sewage so discharged which will injure the hulls of vessels and their paint, both exterior and interior, including war ships and other craft belonging to the United States Government, yachts and pleasure boats.

As an example of the importance of the sanitary condition of New York Bay to the people of the State of New York and people generally I may point out that the United States Government owns valuable and extensive property on the upper New York Bay and along the shores of the Narrows, including Government Islands, the headquarters of the Department of the East, United States Army; Fort Wadsworth, Fort Tompkins, and Fort Hamilton; Ellis Island, where all steerage passengers from abroad are transferred from the steamers in which they arrive; Liberty Island—known also as Bedloe Island—on which is Fort Wood, where a United States Army Station is located, and on which stands the Bartholdi Statue of Liberty presented by the French people to the U. S.; an anchor station off Stapleton in Upper New York Bay for war ships; ferry-boats from the Battery to Ellis Island, and from the Battery to Bedloe Island and Fort Wood; also boats which run to and from the various government stations, the Brooklyn Navy Yard and Sandy Hook; also several lighthouses, and the Brooklyn Navy Yard, the foremost naval station in the country, situated on the East River, with its docks and United States warships under construction and repair; that the government maintains many residences and barracks on these various properties, and I believe that the persons engaged in these government services as well as innumerable visitors, travellers and seamen will be seriously affected, and their health injured, by the discharge of the effluent from the Passaic Valley sewer as proposed, which sewage or effluent will wash up on the shores of some or all of these properties, creating at times an unpleasant and offensive stench, and a nuisance, and rendering life uncomfortable for persons living on the said government properties or passing to and from said properties or otherwise over the bay of

New York, especially near the dispersion area, and will render the said properties less valuable for the purposes for which they are now used and intended to be used hereafter.

Moreover, in as much as the proposed acts of the defendants will be repeated and continued from day to day without limit of time, to the manifest and irreparable injury of the property of the United States and the people of the State of New York, and to the health, comfort, and welfare of people living and employed upon the harbor shores, and to passengers or persons travelling over the polluted area engaged in commerce, I believe they should be forbidden also, in the light of modern sanitary science and engineering methods, I believe that there are other, better, and more advanced methods for the disposal of the sewage of the Passaic

Valley than those proposed and planned by the Passaic Valley Sewerage Commissioners, so that the method adopted, which I believe to be to the manifest and continued injury of the commerce and navigation, the public health, the comfort and convenience of the port aforesaid, and the property of the people of the State of New York and of the United States, is neither wise nor necessary.

Q. Have you examined the stipulation agreed to between the United States Government and the State of New Jersey concerning the Passaic Valley plans?

A. I have examined it with a good deal of care, and I believe it to be from the sanitary point of view an unfortunate and unsatisfactory agreement. It seems to me to have been drawn up by engineers rather than by sanitarians and to be unsatisfactory from a sanitary or public health standpoint.

Q. In what particulars do you find that so?

A. My principal objections to it are, first, that it permits the direct transfer of a vast quantity of putrefying liquid to be carried away from its natural purification basin and deposited still more putrid and without purification in the waters of a different sanitary area, to wit, New York Harbor. In the second place, I do not believe that the screening as proposed will remove at all times and under all circumstances materials visible to the naked eye, but that on the contrary, in spite of such screening, these will be carried into New York Bay and be readily visible. Finally, I do not believe that the means contemplated will be adequate to produce the results required. And especially I do not believe that the steps proposed to be taken will prevent either a nuisance or injury to the public health or interference with major fish life in the waters of New York Bay.

Q. Speaking broadly from a sanitary standpoint, what is the present condition of New York Bay?

A. New York Bay is already heavily polluted, and although it is a good example of what can be done by mere dilution in the way of avoiding for a long time an intolerable nuisance, it is nevertheless dangerously loaded with polluting matters and rapidly approaching the time when it will become an intolerable nuisance.

Q. Is your opinion that you have now expressed given merely

as theoretical, or is it based on any experiments anywhere with which you are familiar.

A. My opinion is partly theoretical and partly based upon the striking experience which befell the city of London in 1868 and 1859, when the River Thames previously heavily loaded with pollution became overloaded and caused an intolerable nuisance.

Q. Will you describe more fully that peculiar experience?

A. I will and by reading—

Mr. Riker: Excuse me, Professor. I desire to object to it as incompetent and immaterial.

The Commissioner: Note the objection for Counsel for Defendants.

Q. You may proceed, Professor?

A. By reading from my own book entitled "Principles of Sanitary Science and the Public Health" pages 354, 355 and 356, but before reading the quotation, I may — that this is taken from a famous book on typhoid fever by a distinguished English authority, Dr. William Budd. The quotation is as follows: "For the first time in the history of man, the sewage of nearly three millions of people had been brought to seethe and ferment under a burning sun in one vast open cloaca lying in their midst. The result we all know.

3283 "Stench so foul, we may well believe had never before ascended to pollute this lower air. Never before, at least, had a stink risen to the height of a historic event. Even ancient fable failed to furnish figures adequate to convey a conception of its thrice Augéan foulness. For many weeks the atmosphere of parliamentary committee rooms was only rendered barely tolerable by the suspension before every window of blinds saturated with chloride of lime and by the lavish use of this and other disinfectants. More than once in spite of similar precautions, the law courts were suddenly broken up by a insupportable invasion of the noxious vapor. The river streams lost their accustomed traffic, and travelers pressed for time often made a circuit of many miles rather than cross one of the city bridges.

"For months together, the topic almost monopolized the public prints. Day after day, week after week the Times teemed with letters, filled with complaint, prophetic of calamity, or suggesting remedies. Here and there a more than commonly passionate appeal showed how intensely the evil was felt by those who were condemned to dwell on the Stygian banks. At home and abroad the state of the chief river was felt to be a national reproach. 'India is in revolt and the Thames stinks' were the two great facts coupled together by a distinguished foreign writer to mark the climax of a national humiliation. But more significant still of the magnitude of the nuisance was the fact that 5 millions (of pounds) of money were cheerfully voted, by a heavily taxed community to provide the means for its abatement. * * *

Commenting on this quotation I see on page 355: "Dr. Ord re-

ported to the Privy Council in 1859 that in 1858 (the year of the worst stench) steamboat men on the Thames suffered severely from languor, headache, sorethroat, nausea, giddiness, mental confusion, &c. (in other words from symptoms of poisoning). In 1859 the river was much better and very few such symptoms occurred. * * * 'In both years the presence of sulphuretted hydrogen in the river atmosphere was shown by the rapid blackening of paper soaked in solutions of lead and by the discoloration of the paint of vessels.' * * * Second report of medical officer of the Privy Council for 1859, p. 55. London, 1860."

Now, concerning these quotations I desire to state that in introducing them and commenting upon them, I point out in my book, that although the symptoms of ill health just described were observed, no epidemic diseases such as typhoid or Asiatic cholera and no great plague or pestilences such as the people had expected to result did in fact occur. On the other hand as already stated, among the rivermen, the members of Parliament, and others upon or near the river, great discomfort and some actual nausea, giddiness and other symptoms of sickness did occur.

Q. Do the petrescent gases that you have mentioned, sulphuretted hydrogen, methane, those other products of anaerobic bacterial activity, do they deplete the vitality and diminish the resistance to the invasion of disease from other sources?

A. That is the current belief of students of Public Health Science, and while it is not easy to prove it, or to give specific examples, the ones which have just quoted, do it seem to me, establish the fact beyond all peradventure. And furthermore, common human experience shows and teaches that one's condition for work or play, what I may call the fine edge of life can be very materially interfered with and in an unfavorable direction by the breathing of gases of putrefaction.

2285 Q. Is it your opinion, Professor Sedgwick, that fresh air with its usual amount of oxygen, increases efficiency as against foul airs, such as you have described.

Mr. Riker: Counsel for Defendants will admit that it is not necessary to testify to that.

Mr. O'Sullivan: Your witness.

Cross-examination by Mr. Riker:

Q. In your various professional associations Professor Sedgwick, have you ever received the degree of Doctor of Law?

A. No.

Q. Have you ever studied legal science?

A. No, never.

Q. And you are not a lawyer?

A. Not a lawyer.

Q. For which you are probably thankful—your are not an expert upon law?

A. Or legal questions.

Q. In expressing your opinion on certain paragraphs of the legal papers in this case, you are simply viewing them from your professional point of view?

A. Simply from the sanitary standpoint.

Q. Now, is it feasible in your opinion, to produce an effluent when discharged at Robbins Reef from the Passaic Valley Sewer which will thoroughly assimilate and diffuse without causing serious or offensive pollutions, and without increasing the present pollution of the Bay of New York?

A. I think it is perfectly possible to produce an effluent which will not cause a serious or offensive pollution, but it probably would not be possible to produce an effluent that would not to some extent increase the pollution of the Bay of New York.

Q. You think it will not be possible to produce an effluent which will produce no more pollution in the Bay of New York than the effluent from Newark Bay now produces in the Bay of New York?

A. I think it would be entirely possible to produce an effluent, if I understand the question, to produce an effluent which would no more add to the pollution of New York Bay than the discharge from Newark Bay now adds to the pollution.

Q. Then your criticism of the plan is like a number of other witnesses in this case, to the specific devices and processes which you understand are proposed?

A. Certainly, I have no objection to the general purification of the Passaic River. On the contrary, I greatly hope that it may be purified.

Q. And you can conceive of an effluent which can be produced and discharged into New York Bay without any additional injury to the waters of New York Bay?

A. Without any material additional injury, yes.

Q. Well, you say that you have considered the stipulation which is Exhibit No. 135 in this case. If the effluent which is produced will be followed by the guaranteed results contained in that stipulation, do you think that there would be any material injury to the waters of New York Bay?

A. Yes, I think an injury would still result.

A. A material injury?

A. A material injury.

Q. In what would it consist?

A. By adding to the general load of pollution in the Bay.

Q. Will you point out the particular features which in your opinion will be injurious?

A. Certainly. No provision is made here for any extensive purification, so that there would be a large amount of petrescent material poured in there which would tend to reduce the dissolved oxygen and would tend, as I have expressed it, in a general way, to further load the harbor with pollution.

Q. Now, Professor, what are you directing your attention to in the papers there?

A. I looked over all the items.

Q. Of the guaranteed results?

A. Yes. That is those paragraphs numbered 1, 2, 3, 4, and so on.

Q. Assuming an effluent from which when discharged into New York Bay there will be an absence in New York Bay of visible suspended particles coming from that effluent?

A. Yes.

Q. And assuming an absence of deposits objectionable to the Secretary of War of the United States?

A. Yes.

Q. And assuming an absence of odors due to the putrefaction of organic matters contained in the effluent?

A. Yes.

Q. And a practical absence on the surface of New York Bay of any grease or color due to the discharge of the effluent and that there will be no injury to the public health which will be occasioned from the said sewer, the discharge of the said sewer, and no public or private nuisance created thereby, and assuming an absence of injurious effects from the effluent upon the property of the United States in the harbor, and assuming an absence in reduction of the dissolved oxygen resulting from the discharge of the effluent to such an extent as to interfere with major fish life, in what, in your judgment, will there be a material injury done by the discharge of such an effluent into the waters of New York Bay?

A. It seems to me that assuming all these things to be accomplished, there still remains a great probability I will say of damage to the harbor, because to take them one at a time the invisible suspended particles, the deposits that might be objectionable to other people than the Secretary of War, the coloration in the fourth paragraph, they, while practically absent according to some, might be practically present according to others, and in the seventh paragraph, the reduction of dissolved oxygen to an extent which might interfere with minor fish life and might use up the oxygen
3288 which should be saved for other purposes. All these constitute loop holes in the agreement which seem to me fatal to it from a sanitary standpoint.

Q. The visible suspended particles which you speak of. What damage are they going to do in the way of creating a nuisance?

A. They are going to accumulate and become visible deposits later on.

Q. Then they will become visible suspended particles?

A. They may not for some weeks or months.

Q. They would?

A. They would in that case become visible.

Q. The stipulation will not be complied with?

A. I do not see that, because I do not see any limit of time put there.

Q. Then there will be absence in New York Bay of visible suspended particles coming from the Passaic Valley sewage. I ask you if the invisible suspended particles become visible, do you understand the stipulation is complied with?

A. Yes, if they become visible after months or weeks.

Q. Why do you say that, upon what do you base that opinion?

A. It strikes me as common sense.

Q. Will there be absence of visible suspended particles coming from the Passaic Valley sewage if that happens?

A. I should think so, yes.

Q. Where will they come from then, these visible suspended particles?

A. They would not be visible suspended particles, they would be deposits. They would not be in suspension any more.

Q. They are not visible then, are they?

A. Yes, they will be visible.

Q. They will not be visible in the waters?

A. En masse, but not individually in the water coming from the dispersion area.

3289 Q. So the damage that will be done, will then be from deposits which will not have been visible at any time in the waters of New York Bay.

A. That is the point exactly.

Q. What harm are they going to do?

A. They may shoal up the channel and blacken the shore and change over into decomposing materials which will cause putrefactive odors later on.

Q. As a sanitary expert you are willing to say that in your opinion that will happen if the purification of the effluent is of the character that is described in the first paragraph?

A. I am, I think it is probable that it will happen.

Q. Well, if they shoal up the channel, do you conclude that the deposit of this material will or will not be objectionable to the Secretary of War?

A. I have no knowledge of the Secretary of War.

Q. I understand you have not—do you think it would be objectionable to the Secretary of War?

A. I certainly do, yes.

Q. Now, assume that he is a man of reasonable intelligence, Professor, do you think that it will be objectionable to the Secretary of War.

A. I hope so, yes, I should say so.

Q. Then will this stipulation be complied with in your opinion?

A. Yes, because that might come in such a way that it could not be proven to have come from there after a lapse of time.

Q. It is a question of proof not the actual doing of the thing?

A. Most things are a question of proof.

Q. They are in a way, but is not it far more important, the question of doing them in your judgment?

A. That is a fine point which I am afraid I cannot follow.

3290 Q. Where a stipulation provides that certain things shall not be done, do you assume that they will be or will not be, whether it is a question of proof or not?

A. I assume they will not, of course.

Q. If you cannot prove that it is not carried out?

A. I do not know that I follow you there.

Q. Now what other injurious effect did you say you thought would occur if the stipulation is complied with?

A. I said, if I remember rightly, that there might be what one would call a practical absence on the surface of New York Bay of any grease or color, while to another it might be practically present, and it seems to me therefore that that was a worthless stipulation or item. I would not say worthless, that it makes the carrying out of the entire scheme, the administration of the entire scheme difficult, if not impossible.

Q. What part of it did you criticize, the use of the word "Practical?"

A. Yes.

Q. If it were said to be an absence of grease or color, would it not be subject in your judgment to the same objection, that to one person there might be absence, and as to another, there might not be?

A. To a less extent, certainly.

Q. It is a question of degree, not of kind,—that is what you mean?

A. Well, I think that absence and presence are easier to determine than practical absence and practical presence.

Q. The question of proof as applicable to practical absence, is not that question of proof applicable to the oxygen, or the absence on the surface of color?

A. Certainly. I suppose it would be covered. It is a matter of proof in both cases.

Q. The only question of difficulty that you would have
3291 is what constitutes the standard of practical absence as distinguished from absence?

A. So far as that paragraph goes.

Q. That is your criticism of that paragraph?

A. Yes.

Q. Now the other was that the dissolved oxygen might be reduced to a point where it would interfere with minor fish life as distinguished from major fish life?

A. Yes.

Q. Well, what point is that?

A. Nobody knows, but my idea was this. That the seventh stipulation is so indefinite that to begin with nobody knows at what point major fish life will be interfered with by the reduction in the dissolved oxygen, but assuming that that could be established, there still remains other kinds of fish life, and I use that simply as an example of the fact that the dissolved oxygen would be reduced, and thereby the burden laid upon the harbor increased. I used minor fish life only as an illustration.

Q. Well, what special purpose have you in mind for which the dissolved oxygen in the harbor is especially desirable?

A. For the general cleanliness of the harbor. On account of the inevitable pollution that will always get into everything that is used by the public.

Q. And do you or do you not include in that sewage discharged into the waters of the Bay from New York City?

A. Well, I think that should be included, but I did not include it because I was assuming that this material was going in as described, and that the water at Robbins Reef was the water of New York Bay unpolluted by the State of New York. It would still under those conditions be a heavy burden upon that water in my opinion. Not probably an intolerable burden but a heavy burden.

Q. Well, now, to what extent, if it reduced the percentage
3292 of dissolved oxygen, do you think that it would be a burden to the waters of New York Bay, assuming the condition which you seem to have assumed that it should not be polluted by the State of New York?

A. I cannot answer that, because I do not know what the dissolved oxygen would be under those conditions, or how far it would be reduced, but I do know it would reduce it.

Q. You know as most intelligent men know that the introduction of organic matter in any form into the waters of New York Harbor will tend to reduce the dissolved oxygen?

A. Certainly.

Q. And from the exclusive sanitary point of view it is your opinion, is it not, that it is desirable to exclude as much as possible of organic matter from the waters, the harbor or the bay?

A. It is.

Q. And that is about all that you do mean, isn't it?

A. That is about all I do mean on that, yes, although there is a choice in the organic matters to be put in. Organic matter is a very broad term. Sewage matter is the worst kind of organic matter.

Q. I would extend it to that point that the organic matter, which is peculiarly a part of sewage, should be, as far as possible, excluded from all waters?

A. Certainly, I should like to see the organic matter increased provided that the organic matters were major fish life, not microbes though.

Q. You would exclude the organic matter from sewage proper so called, from all inland waters, so far as possible?

A. So far as practicable.

Q. Would it not be desirable to exclude it entirely?

A. That depends. There are certain conditions under which a stream or body of water is not good for anything except a cesspool and sometimes it is worth while or might be worth while to
3293 use it for that purpose alone, but that would be very rare.

Q. You do not apply that to New York Bay for instance?

A. No, sir.

Q. And I think you said that you now considered the Island of Manhattan and the Brooklyn shore and Coney Island, and Bath Beach as properly described as bodies of land surrounded by sewage?

A. I said there was great danger that they would become so, and they have been so described. I think I did not say they actually are.

Q. You do not concur in the description of the Island of Manhattan as a body of land surrounded by sewage?

A. Yes, if we say diluted sewage.

Q. And where does the sewage come from which has rendered the Island of Manhattan a body of land surrounded by diluted sewage?

A. Mainly from the Island itself.

Q. Are you familiar with the conditions in the Passaic River?

A. Fairly so.

Q. Well, the conditions there existing, do you think they should be continued and increased?

A. Decidedly not. They are intolerable.

Q. And to the extent to which the Passaic Valley project involves simply the purification of the Passaic River, you approve of it, do you not?

A. Heartily approve of it.

Q. Do you think that it would be a desirable thing to divert the sewage and discharge it into the Newark Bay. Do you think that would be a proper plan of disposing of it.

A. That would not be the proper method of disposal, no.

Q. Do you think that would be a tolerable disposition to make of the sewage of the Passaic Valley?

A. Intolerable.

Q. Notwithstanding its special adaption for purification purposes to which you testified?

A. Notwithstanding that.

3294 Q. By the way you said that one of the elements of the special adaptability of those waters for purification, was the temperature of the water, due to its shallowness?

A. Yes.

Q. Is that a matter of summer temperature?

A. Well, of course in winter it works the other way, but this matter of sewage disposal is very largely a summer question.

Q. You mean by that, that conditions in the summer are more likely to develop injury from the same quantity of sewage by reason of the high temperature?

A. Yes. Of course sewage must be disposed of all the year around, but sewage disposal in winter is a comparatively simply matter so far as the production of a nuisance is concerned.

Q. Do you think there is any less sewage matter discharged from a given community in winter than in summer.

A. Probably more, sometimes.

Q. Now, you have suggested that there was some other plan of disposing of the sewage of the Passaic Valley which would be preferable. Would you mind indicating what you have in mind?

A. I have made no special study of the problem over there, but in going up Newark Bay, the other day, I was struck with the fact that there is a vast body of almost useless water from the shores of which it would be easy to build out enough to locate a sewage purification works for that whole valley. I mean, given a sufficient sum of money.

Q. You understand that the disposal plant that is contemplated in the project is to be located on Newark Bay, do you not?

A. Yes, I do.

Q. And to that extent, the plan that has been adopted, as you understand it, seems to be the one that would be the normal and natural one?

A. It seems to be decidedly so, to bring the sewage down
3295 to some such point as is indicated upon the plan, and there to treat it to such an extent that it could be put directly into Newark Bay without creating nuisance.

Q. Your idea is that the effluent should be purified to the extent which it could be discharged into Newark Bay?

A. Or into New York Harbor.

Q. Or into New York Harbor, either one or the other?

A. It makes no difference.

Q. The effluent in either case should be equally purified.

A. It should.

Q. Do you think that a greater purification or less would be appropriate to the discharge into Newark Bay as compared with the New York Bay.

A. Well, I should think that from the standpoint of public welfare, it ought to be a little better purified, to go into New York Bay than into Newark Bay; simply because, as I have already said, Newark Bay is a remarkable purifying basin as it is, and it would have the advantage in passing of a still further purification before reaching a large population.

Q. But assuming equal financial importance to the shore surroundings of Newark Bay, with those of New York Bay?

A. I should then make no difference.

Q. Do not you think that it makes any difference that Newark Bay is shallower so far as the character of the effluent which should be discharged into it, is concerned.

A. Yes, I think that in view of its shallowness and of the fact that it oscillates back and forth a good deal less probably that, if it is desired to prevent a nuisance, it would have to be purified fully as much. On second thought, possibly even more than it would in the other case.

3296 Q. Will the fact that the width of Newark Bay is very appreciably less than the width of New York Bay affect the question of the extent of purification, to your mind?

A. I should not think so very much, no.

Q. You do not think the near approach of the same character of improvement along the shore would affect the character of the effluent, should affect the character of the effluent?

A. Yes, if the shores are being built upon with the same sort of population and manufacturers, I think that the same remedy should be applied, and especially in view of the fact that there is a smaller volume of water there. I think that the purification would have to be fully as great as it would in New York Bay.

Q. And it might have to be greater?

A. Probably greater, yes.

Q. What injurious effect in Newark Bay in your judgment will be produced by an effluent producing in New York Bay the guaranteed results contained in the stipulation?

A. Well, I think it would produce practically the same results, but possibly—yes, I will not say but possibly—but probably exaggerated because of the smaller volume of water, the smaller movement and the shallower Bay.

Q. You appreciate, Professor, that the plan which is proposed of discharging into New York Bay at Robbins Reef involves the expenditure of several millions of dollars as compared with the discharge into Newark Bay, do you not?

A. I do, yes, and I cannot see why, if all the things in the stipulation should be carried out, and all the results reached, which it is alleged will be reached, that the same effluent might not go directly into Newark Bay without so great an expenditure and 3297 without the production of very much greater nuisance.

Q. But you would anticipate a greater nuisance in Newark Bay?

A. I think it would be somewhat greater, perhaps, decidedly greater.

Q. You have spoken of anticipated injuries in New York Bay from the discharge of this effluent, and one of them, as I remember, was the injury to the property of the United States. If the guaranteed results are produced by the effluent discharged into New York Bay, do you think that the contemplated injury will result?

A. I think it will, yes.

Q. Well, I draw your attention to the guaranteed results that being the sixth item, absence of injurious effects from said sewage discharged upon the property of the United States situated in the Harbor of New York?

A. Of course, if all injurious effects are avoided, there will be no injurious effect. That is perfectly obvious.

Q. That seems to be an absolutely logical inescapable conclusion?

A. I see no escape from that.

Q. Now, I ask you again that if the effluent discharged into New York Bay produces the guaranteed results, do you mean to say that you think there will be any injury to the property of the United States in the harbor of New York?

A. No, logically speaking. Paragraph 6 seems to cover all that point.

Q. That seems to exclude the injuries which you testified to?

A. But I do not believe that the means proposed will produce the results guaranteed.

Q. Well by that you refer to the sedimentation and screening processes?

A. Yes.

Q. And you do not have in mind any requisite additional arrangements?

A. I do not understand.

3298 Q. I say have you in mind the agreement on the part of the Passaic Valley Sewerage Commissioners to adopt other requisite lawful additional arrangements?

Mr. O'Sullivan: I object to that question on the ground that it calls for a juridic interpretation of what is and what is not lawful relative to additions to the plant described.

The Commissioner: Note the objection of Counsel for Complainants.

A. I have noted that provision and I have no doubt that additional arrangements could be made which would do away with all my sanitary objections. Whether these would be lawful or not, I am unable to state.

Q. Not being a lawyer?

A. Not being a lawyer and not being familiar with the statutes of New Jersey or of those municipalities.

Q. So far as you are acquainted with additional processes and devices for purification, do you know of anything that is unlawful about them?

A. No, although I have observed, that one of the first things that people have to do in these cases is to go—in Massachusetts—is to go to the Legislature and get authority to issue bonds and to go beyond the debt limit and to do all sorts of legislative and legal things before the work can begin.

Q. Well, would in your opinion not the same dilemma present itself to you if the word "lawful" had been left out of the stipulation. In other words, in your opinion, can the State of New Jersey or the Passaic Valley Sewerage Commissioners undertake to do anything that is not lawful?

Mr. O'Sullivan: The same objection.

The Commissioner: Note the objection of Counsel for Complainants.

3299 A. They can undertake it, but whether they can carry it out I suppose might be a question. Now, I think if the word "lawful" were omitted and if I were satisfied that these commissioners could get the necessary funds when the time came, I should consider that pretty satisfactory.

Q. A pretty satisfactory result to be obtained?

A. Because all I ask is that there shall be requisite additional arrangements.

Q. To produce the guaranteed results?

A. To protect the people of the State of New York or to avoid a nuisance or injury to the public health of New York or New York Bay.

Q. If the guaranteed results are produced by the specific things or by additional requisite arrangements, is it not your opinion that the result would not be satisfactory?

A. No, I cannot say that is is. I think I could draw up a better set of protective arrangements than this.

Q. Professor, have you in mind that the City of New York, which we are assuming for the purpose of this question as having four million and a half inhabitants of its own, is discharging crude sewage into these waters and do you think that this stipulated result, or these stipulated results could be said by any one to be other than satisfactory, for the effluent from the State of New Jersey discharged within the territory of the State of New Jersey?

A. I certainly do.

Q. You think that while New York is discharging crude sewage to such an extent into the harbor that the State of New Jersey should be prevented from discharging any sewage into the harbor, is that your view?

A. No, I think that sewage effluent should come in and I think that New York should be prevented from doing the same thing that I would ask to have New Jersey prevented from doing.

Q. And do not you think that before New Jersey should be prevented from doing these things that New York should be prevented from doing what she is doing?

A. If that were practicable, yes.

Q. Whether it is practicable or not, what do you mean by practicable?

A. I mean that it would be comparatively easy to construct in the New Jersey scheme as here laid down, and comparatively difficult to stop New York putting in its sewage, New York City.

Q. Comparatively easy. Now what do you mean by that, Professor?

A. I mean that it is simply a matter of money to take the sewage there on those meadows and do the thing, whereas it is not simply a matter of money in the case of New York.

Q. Why, isn't it?

A. Because of the magnitude of the problem. There is great danger that if New York should spend hundred of millions in putting its sewage somewhere, that it would still not be satisfactory. The magnitude is so enormous. It needs in both cases, I say, the most careful study. What I hope is that the two states will get together and appoint a joint sewerage commission and study this thing out.

Q. With the idea that the state of New Jersey should incur expense in order that the State of New York should be saved from expense.

A. The reverse.

Q. Why in your opinion should not the same degree of cleanliness apply to the State of New York as applies to the State of New Jersey?

A. I would only exact the same from each.

Q. Why would you not require the same effluent from the State of New York that you would require from the State of New Jersey?

A. I should be very glad to require it, only in one case it seems

3301 to me within the bounds of human labor within a reasonable time. In the other case it seems to me beyond our power within the same time, but eventually I hope to see both of them acting up to the same degree of cleanliness.

Q. Is it not impracticable in your judgment, for New York to adopt the same standard of cleanliness that you think is appropriate for the State of New Jersey?

A. No, sir, I think they ought to have the same standard. It is perfectly practicable, but it would probably take a long time to work it up.

Q. And where would you suggest the discharge of this purified effluent from the State of New York?

A. Why, I should hope it would be good enough to put right into the bay in both cases.

Q. Would it be an effluent in your judgment of any higher quality than that which is guaranteed in this stipulation?

A. It certainly would.

Q. It would in what respect?

A. I should want to see it put through some sort of a filtration plant before being put into New York Bay. It is possible that either of those might be carried out to the deep sea, either the New Jersey or the New York sewage. If it could be carried far enough, but that is a very serious question that I do not feel sure about.

Q. You think that it is practicable for the State of New Jersey to carry its sewage from the Passaic Valley out to sea?

A. Except for the expense.

Q. Is not that the thing that you said was impracticable for New York in the matter of the expense?

A. I think it may prove to be so at present, but I hope in the future that New York will be able to afford anything.

Q. You would suggest that New Jersey be compelled to carry its sewage by a long line discharge pipe out into the ocean?

A. I have not suggested anything of that kind. I only
3302 said that it was possible to do it, without producing nuisance.

Q. You say you think that is a possibility?

— I think it is a possibility, barring the financial question.

Q. It is possible for New York to do the same thing?

A. Entirely.

Q. Are you aware that this stipulation is entered in'to under the direction of the responsible officers of the Government of the United States?

A. I suppose so.

Q. And you are disposed to criticize that, are you not?

A. I am, yes.

Q. You set up your judgment as against theirs?

A. Unfortunately I have to do so.

Q. You have in mind the fact that those matters to which you have testified are the matters which they had under consideration and discussion?

A. I presume so, I have no doubt of it. It is simply, as I said, I believe they were mostly engineers rather than sanitarians.

Q. Do you know?

A. No, I do not.

Q. Then why do you say it?

A. Judging by the result of their work.

Q. Now if you were called upon to introduce into this stipulation matters which you think are essential, what would you suggest?

A. Well, as I have already intimated, I should be disposed, although I have not made a study of the whole problem, such as ought to be made by any one who is making the stipulation, I should be disposed to require some form of filtration.

Q. Well, Professor, do you think that the specification of any particular form is more effective than to say that by requisite lawful arrangements certain results should be obtained?

A. Yes, I think so, because it is specific. The other is loose general, it seems to me.

Q. You lay more stress then upon specifying the processes or devices rather than the results, do you?

A. No, I think I should be willing to be guided by the result, but I should make the result one which could only be reached by certain processes.

Q. Let us hear what the result is that you would suggest?

A. I should require a result as for example that the putrescibility should be looked over, and I should put such a standard as would practically require filtration.

Q. Anything else, any other change that you would make?

A. I think that is the principal thing.

Q. And you would retain the other provisions of the guaranteed results would you?

A. As far as I can say without being put in such a responsible position as that.

Q. How much reduction of putrescibility would you require?

A. I should not be willing to say off hand. I think it would require a good deal of study.

Q. Do you think 10 per cent. of the putrescible content is enough?

A. I should think that might do. I am not sure though without more study than I have given it.

Q. Will the devices which are specified in the stipulation reduce the putrescible matter more than 10 per cent.?

A. I think it is possible that they will, yes, taking the crude sewage.

Q. Then you would require more than 10 per cent.?

A. If that is so, yes.

Q. Have not you made any investigation to determine how much the processes will affect the putrescibility of the sewage?

A. Yes, but there are so many different processes, and the sewage vary so much. Trade wastes and all sorts of things, here, for instance, the presence of acid, acids interfere with the action of bacteria. The question is too complicated to answer off-hand. That is a part of my objection to this stipulation, that they do not seem to have been studied with sufficient care. I

am certainly not willing to answer that without a good deal of study and care.

Q. But the chief amendment that you would introduce would be a degree of putrescibility in the effluent, is that it?

A. I should think that would be one of the principal things, perhaps the principal thing, although I should want the organic matter, the materials all looked carefully over. The trouble now is that this proposes to put a load of septic or putrescent sewage into the Bay. I would avoid that somehow.

Q. Why do you designate it as septic or putrescent sewage?

A. Because it would be stale by the time that it reached Robbins Reef and staleness means septicity and putrescency.

Q. So that notwithstanding the treatment that it is to receive and notwithstanding that it attains the results which are guaranteed,—

A. Certainly notwithstanding the treatment. Of course if all these results can be reached, and are reached, particularly at all times and all seasons, it is possible that no material damage will come, but I do not feel certain that is the case, and I do not feel certain that these results will be reached all the time.

Q. Are you certain about anything in this life that is in the future?

A. Not many things, no.

Q. Except you are reasonably certain of the rise and fall of the tide and the rise and setting of the sun?

A. There are certain things—

Q. And death and taxes, those you are reasonably certain
3305 about, but any other things, you cannot be certain that they will occur. Any form of stipulation depends, does it not, upon whether it is actually carried into effect?

A. Certainly.

Q. A paper stipulation does not carry itself into effect?

A. Not necessarily.

Q. But assuming that these stipulations shall be carried into effect by the Passaic Valley Sewage Commissioners, do you think that it is a proper description of the effluent to say that it will be septic and putrescent when discharged at Robbins Reef?

A. Yes, I think it will, because I do not see anything in these stipulations, or requirements which will prevent that. They do propose to prevent odor and deposit and color and grease and damages and so on, but there is nothing said about their preventing putrefaction or septicity.

Q. Well, those Latin derivatives are not in themselves terrible, are they?

A. Generally not.

Q. What are the injurious things which will accompany in your judgment this sewage described by these derivatives in New York Bay if the stipulation is carried out in good faith and according to its terms?

A. It is as I have already said. If septic, stale and putrescent sewage arrives in that Bay it will in the first place so to speak devour or absorb oxygen, and that diminishes the resources of the harbor.

Q. But, Professor, you have already said that there were certain waters which in your judgment were very appropriately devoted to ~~camp~~ pool purposes?

A. Certainly a few.

Q. The reduction in the dissolved oxygen of those waters would not be injurious?

A. No.

Q. In what respect is the reduction of the normal oxygen in the unpolluted waters of New York Harbor likely to be injurious in your opinion?

A. Only as rendering those waters less capable to handle whatever inevitable contamination came in from the water shed.

3306 —. How much reduction in the normal oxygen content of the pure waters of the Bay of New York as we may imagine it to have existed, when Hendrik Hudson first sailed up it, do you think will produce results which are at all likely to be injurious in any respect?

A. Of course that would probably have to be a very large reduction, but we do have such reduction by deposits in the waters—in drinking waters. The bottoms of some drinking water reservoirs are destitute of oxygen and are stale and stinking, so that they have to draw the water from the top. I am not talking merely about theoretical conditions there. There is a real use for the oxygen of an unpolluted water in looking after the disposal of the inevitable organic matters which find their way in, the dead fish and washings from the near fields in agricultural districts.

Q. You are not thinking of the waters in New York Bay as potable waters?

A. I do not suppose that the oxygen in the normal New York Bay was ever so reduced.

Q. Do you concur in the view that it is safe to reduce the oxygen in the waters of New York Bay to 50 percent.?

A. I should doubt very much if it was, because with the increased population and the inevitable pollution, even if every town on the Hudson River and the City of New York and all the rest should purify their sewage, they have got to put the effluent somewhere. That effluent will undoubtedly take some oxygen no matter how good it is and that effluent plus the inevitable pollution that I have referred to will eventually make it so that we must not reduce the oxygen in New York Bay even to 30 per cent. by sewage.

Q. Even by 30 per cent. you mean?

A. By 30 per cent. leaving 70 per cent. oxygen, yes.

Q. Do not you know that the oxygen in the East River is now reduced to 55 per cent.?

A. I dare say it is at times, a good deal lower in some
3307 places.

Q. And on an average don't you know that that it is a fact?

A. Yes.

Q. And at the mouth of the Hudson River don't you know that the oxygen averages about 55?

A. Yes, I think that is dangerously low.

Q. Now, assuming the normal oxygen content in New York Bay unaffected by the contaminations, do you think the discharge of the effluent as guaranteed in this stipulation, assuming the maximum population, will that effluent reduce the oxygen content, and how much?

A. It is a mere guess, but I suppose it might in that case mark it down in the immediate vicinity of the discharge to 70 per cent, I should say.

Q. Professor, when you say the immediate vicinity, won't you indicate what you have in mind?

A. I mean within a range of half a mile, and that, of course, only at times. It would depend on the rush of the water and all sorts of things.

Q. Take the whole content of New York Bay, if you have any way of judging what is it. Have you any idea what the diminution in oxygen would be from this discharge?

— Very small. Probably infinitesimal. Assuming the bay to be unpolluted.

Q. You have testified in your direct examination with reference to riparian conditions so far as they are involved in sewage disposal. How far do you think the proper riparian territory extends from any given point. For instance, take the Passaic River at the Center Street Bridge in Newark. How far up the stream do you think a fair riparian right of discharge at that point might exist?

A. I should suppose all the way up.

Q. How far down?

A. It is more a matter of down than up.

Q. How far down then?

A. I should suppose to the mouth of Newark Bay, for instance. That is the natural drainage area of that region, and it is where the tides go back and forth and things settle.

3308 Q. And so far as the territory, we will say, at Elizabethport, do you know where Elizabethport is?

A. In a general way, yes.

Q. So far as property along the shore at Elizabethport is concerned, you think that the right to discharge sewage at Elizabethport belongs to the whole ripa upon the river as far as Paterson?

A. I should think there it was shared with Elizabethport, that region. Yes, I should think they had certain rights there, but not the principal right.

Q. You think that Paterson would have the right to come out with its sewage and discharge it at Elizabethport?

A. Not the principal right, no.

Q. Is it not a fact that the sewage of Paterson discharged in the upper regions of the Passaic River will have been very measurably purified by the time it reaches Elizabethport?

A. Yes, and that is just the basis of my idea, that the true sewage riparian right is at Elizabeth. From there down the right diminishes from the purification.

Q. And that applies to all the towns and villages upon the river to the head waters of the water shed?

A. That is it exactly.

Q. So that there is theoretically no more objection in time, not in degree, but in time, to the discharge of the sewage into New York Bay within the territory of New Jersey than there would be to discharging the same sewage at Elizabethport, for instance?

A. I suppose that is true in kind rather than in degree as you say.

Q. If the effluent which would normally reach New York Bay by means of what you term the natural sewage disposal is produced, of a character which will not materially affect the waters of New York Bay, what is the objection to that effluent?

A. There is not any.

Q. Have you not said that the effluent which is guaranteed here will not in your judgment produce any materially greater or
3309 more injurious effect on the waters of New York Bay than the effluent from Newark Bay does produce?

A. No, I do not think I said that.

Q. I thought you did?

A. I said the effluent might be put into either of the two. If I did say it, it is not true, because the processes of purification in Newark Bay are of such a kind as to make a materially different effluent from that which is proposed to be put into New York Bay.

Q. You think the effluent from Newark Bay is of better quality than that which is guaranteed to be produced under these stipulations?

A. I do decidedly.

Q. In what respect?

A. It is settled and fermented and a naturally self purified effluent. The other is a septic and putrescent effluent, which has only been settled and screened.

Q. You do not think the sewage from the Passaic River when it is discharged from the Newark Bay in the form of a natural effluent is septic?

A. I should doubt if it was a good deal of the time. It did not look so the day I saw it. I saw it from the Bay, out in the Bay.

Q. Why is not it septic?

A. Because it apparently contains oxygen.

Q. It has been purified then?

A. Yes, that is just my point.

Q. In your judgment there is not any injurious effect from the discharge into the waters of New York Bay at the present time of the effluent from Newark Bay?

A. Comparatively little.

Q. Is there any?

A. I do not know. I have not studied it enough to know.

Q. Do you remember me asking you some question along this line earlier in the cross examination?

A. No, I do not.

Q. Do you remember saying that in your opinion the results

would be practically the same from the effluent as is now produced from the effluent from Newark Bay?

A. No, I do not.

Q. If you did say it, do you desire to withdraw it?

3310 A. I do, decidedly.

Q. What in your judgment is included in the water shed of New York Bay?

A. That all depends on whether one is speaking from the point of view of an engineer or from the point of view of a sanitarian. From an engineering point of view the usual answer would be given that all the region which sends its water into the bay is on the watershed, no matter how remote or through what devious channels, but from the sanitary point of view the watershed of New York is simply the immediate vicinity draining directly into it. That is to say it is New York City and Brooklyn and Jersey City and Staten Island, parts of it, and Bayonne, the east side of Bayonne, whatever is immediately in contact with that bay.

Q. How far up, in your judgment, in distance does the immediate contact extend as you understand it?

A. I should think that that would be very difficult to determine. It would be a small distance probably up the river, say opposite New York. Wherever the sewage came in and polluted the water as such. If the sewage was transported, self purified en route, to any appreciable extent, I should say that at that point, we were departing from the sanitary watershed. There might even be a question whether the upper part of New York City would come in under my definition.

Q. Is it not a fact that the transmission of sewage in a water course tends to purify it?

A. In a general way that is true, yes, tends to purify it, yes.

Q. So that the discharge of any sewage from the actual point of production at any point below the destination point is a diversion from its proper point?

A. It certainly is.

Q. So that every sewer then is a diversion?

A. Some purification begins even in the sewer itself.

3311 Q. I ask you whether every sewer from that point of view is not a diversion of the sewage from its natural disposal channel?

A. At the same time sewage does not change with infinite rapidity, and a reasonably small amount of time is certainly required to make it anything but sewage.

Q. Are you familiar with the Bronx Valley Sewer?

A. No, I do not know much about that.

Q. Don't you know whether that is a diversion of the sewage?

A. From what I have heard about it, I should suppose it is distinctly.

Mr. Riker: I think that is all for the present.

Dedirect examination by Mr. O'Sullivan:

Q. Mr. Riker asked you Professor Sedgwick, if sewage transported in a sewer was not a diversion of that sewage from its natural watershed. I ask you if that organic matter transported in the sewer was deposited upon the land, if it would be washed through the water shed into the river that drained the watershed in the normal, natural operation of the element?

A. It certainly would.

Q. You have made a distinction between an engineering water shed and the sanitary idea of a water shed. I ask if you took into consideration in making this distinction the scavenging agency in water, whose function is the purification of the organic sewage matter that is discharged at normal points along that water shed?

A. Yes, it is that process of self purification that I had in mind. A particle of water, pure water falling on a water shed remains a particle of water from the time it touches the ground until it reaches the sea and thereafter, for that matter, but a particle of sewage produced or falling upon the water shed, is subject to change by natural agencies, so that after a longer or shorter time it may even
3312 cease to be sewage, and it is for that reason that I feel strongly that there is a great distinction between a sanitary watershed and what I would call an engineering watershed. The

term of course is not good, but I believe there is a distinction there.

Q. And in the illustration of the application of that principle through an answer to Mr. Riker relative to Paterson and Elizabethport, you stated that the sewage discharged at Paterson, that Elizabethport was entitled to this purification agency or its operation on that sewage, rather than having it discharged in concentrated form. Is that a fact?

A. In my opinion that is a fact.

Q. You described the Passaic River as an elongated septic tank, and the portion of Newark Bay as a sedimentation basin. Is the decanted effluent that comes on the ebb tide better in quality in its oxygen content than the waters that it enters in New York Bay?

A. Undoubtedly at certain seasons it would be better than the water that it entered, but I should think that at other seasons it would not be. It might be worse. That is another illustration of what I mean by the difference between a sanitary water shed and a water shed as ordinarily so called. Processes are at work which purify the sewage and they are summed up in the general term self-purification, but to make a general statement that these would always be at work, and always produce a particular result is impossible. They probably would not.

Q. Will screening and sedimentation remove organic matter in solution from sewage or colloidal matter?

A. Only very slightly.

Mr. O'Sullivan: I think that is all.

Recross-examination by Mr. Riker:

Q. Now, Professor, what in your judgment is the distinction between the rights of the City of Elizabethport near the bay, the City of Elizabeth, and the City of New York to complain of the discharge of an effluent of the sewage of the City of Paterson when discharged at either of those two points?

Mr. O'Sullivan: I object to it unless it is qualified to the
3313 extent of requiring that opinion from a sanitary standpoint, because the question as it lies includes a juridic opinion.

The Commissioner: Note the objection of Counsel for Complainants.

A. The two points being Elizabethport and Robbins Reef?

Q. Yes.

A. And assuming that the same material is coming to both?

Q. Assuming the same effluent?

A. Why, I should think that Elizabethport or Elizabeth had the same right to complain as the State of New York, because in both cases the natural self purification is cut out and the material is piped directly to them.

Q. And in locating an imaginary sewage disposal plant on Newark Bay, which would serve the Passaic Valley, you think that injury is one that could be complained of by the City of Elizabethport properly from a sanitary standpoint of view?

A. Not assuming that a decent effluent is produced, because Elizabeth now has to endure an effluent from a natural purification plant, the Passaic River and Newark Bay. I should say Elizabeth in that case would have no right to complain provided the effluent were as good as the material now flowing out of Newark Bay. I should hope it would be better.

Q. So that from a sanitary point of view, your judgment is that if the effluent was not materially more objectionable from the sewage plant than it is from the natural sewage disposal plant, the artificial sewage plant, than it is from the natural sewage disposal plant, there is no ground of complaint?

A. That I think is perfectly obvious. They have the right now to use the river, to be protected by the river and the bay, and if the effluent were as good as it now is, they would have no right to complain.

Q. Do you think as a matter of fact the up river towns have the right to discharge their sewage into this stream, known as
3314 the Passaic River so as to produce an effluent of the character which exists at Elizabeth?

A. I suppose they have or they would not be doing it.

Q. I am talking from the sanitary point of view?

A. No, not from a sanitary point of view, no indeed, I think that is highly objectionable.

Q. And that is objectionable from the point of view of the City of Elizabeth?

A. That would still be objectionable to Elizabeth.

Q. Now, assume, if you please, that the City of Elizabeth is polluting its own border, so that the effluent which is proposed to be discharged is of a higher quality than that of the waters immediately surrounding the City of Elizabeth. What then do you think of the sanitary situation as to the matter of the rights of the City of Elizabeth?

Mr. O'Sullivan: I object on the ground that it is calling for a juridic opinion from this witness as to the rights of the municipality.

The Commissioner: Note the objection of Counsel for Defendants.

A. It seems to me that Elizabeth has no moral right to object unless she has cleaned or is about to clean her own skirts.

Mr. Riker: That is all.

Mr. O'Sullivan: I think that is all.

Adjourned to September 20th, 1912, at 10:30 A. M.

3315 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

CORPORATION COUNSEL'S OFFICE,
NEW YORK CITY, September 20, 1912—10:30 o'clock a. m.

Before James D. Maher, Esq., Commissioner.

Appearances:

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

PAYN B. PARSONS a witness called on behalf of Complainants, recalled for further examination, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. You testified previously in this suit?

A. Yes.

Q. Are you still holding a position with the Metropolitan Sewerage Commission?

A. Yes, I am.

Q. And what is that position?

A. Bacteriologist.

Q. Are you actively engaged in the performance of your duties?

A. Yes, every day.

3316 Q. Dr. Parsons I hand you Complainants' Exhibit No. 195 and ask what you know in relation to it?

A. Well, this is a report that I made to Dr. Herbert D. Pease, Vice President of the Lederle Laboratories in 1910. Filed report signed July 1st, 1910. I made this report while working for the Lederle Laboratories and it consists of report of the Sanitary Conditions along the Staten Island shores abutting on the Lower Bay, and was made in connection with the oyster industry, and this is the report as I handed it in to Dr. Pease signed by me.

Mr. O'Sullivan: Your witness.

Mr. Riker: No questions.

Mr. O'Sullivan: That is all, Doctor.

WALTER BENSEL, a witness called on behalf of complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your profession, Doctor?

A. I am a physician.

Q. Where did you pursue your professional studies?

A. At the College of Physicians and Surgeons in the City of New York.

Q. When did you graduate?

A. Graduating in 1890.

Q. Did you pursue the practice of your profession after that?

A. I have, ever since that time.

Q. Did you pursue your studies anywhere else?

A. Well, I pursued various studies in various hospitals. I do not know that they have anything to do with this particular experience. I was in Bellevue Hospital for two years, the Vanderbilt Clinic, and in the Polyclinic Medical School and Hospital where I was a lecturer on Surgery. In 1892 I entered the Department of Health and have served continuously from 1892 to the present date in various grades, until I now hold the commission—a civil service grade, the highest that can be held in the Department.

3317 Q. Are you a member of any professional bodies?

A. Many medical societies.

Q. Have you contributed to the literature of your profession?

A. I have not had a great deal of time to write, Dr. O'Sullivan.

Q. Do you now hold an official position?

A. I am Sanitary Superintendent, attached to the Department of Health, of the City of New York.

Q. Have you got assistants under you?

A. Five of them, one for each Borough. The Sanitary Superintendent, I might mention, is the chief of the Sanitary Bureau, and the Sanitary Bureau is about four fifths of the Department of Health.

Q. Are you the chief of that Bureau?

A. I am the chief of the Bureau; I also hold the position of head of the Department of Hygiene and Preventive Medicine, Columbia University.

Q. Are you familiar, Dr. Bensei with the harbor waters of New York?

A. In the course of my official duties it has become necessary many times to take action with respect to conditions which have arisen from harbor pollution.

Q. Now, taking the North and East Rivers, will you state their condition?

A. The condition may be stated in several different ways. In the first place the North and East Rivers are polluted to very considerable extent, so that it has become necessary for the Department to take action to limit the bathing which is allowed, along various situations, until at present the public baths have been reduced to about 5 in Manhattan, 4 in Brooklyn, and 2 in the Bronx. That is along all the water front of those three boroughs, there are now only 10 or 11 baths. This has been due entirely to the condition of the water which renders it unwise to allow bathing

3318 to any greater extent. These baths even this Summer were allowed merely as a tentative proposition with the idea of further cutting down the number next year, providing the City could make other arrangements for bathing for the people that required it. There is a great deal of trade waste which is run into both the North and East Rivers, and of course this trade waste is of a highly putrescible or decomposable nature. At the present time, with sufficient oxygen, it does decompose. It is a question of how much more pollution could be added, before, instead of decomposition taken place, putrefaction will take place, and very offensive conditions arise. Putrefaction does take place and has taken place at the mouths of sewers, so that in ferry slips, even at the present time, the nuisance in hot weather is so great as to be an offence to common decency. It is a common belief that the odors which arise from fields, such a field as is found at Rikers Island, is due in large part to the character of the material which is placed there. As a matter of fact it is due much more largely, probably in 75 per cent. of the nuisances, to the character of the bottom of the river or the harbor which is being filled in, and which is caused to rise above the surface of the water by the pressure of the filled in material. The deposits of decomposing material, while they are kept at the bottom of the river or harbor, do not cause any great annoyance, but as soon as they are brought above, and exposed to the elements, then they become very, very offensive. So that is another one of the causes of pollution of the waters of the East River, and that is one of the things that our Department has to take action concerning very frequently.

3319 That is about the situation so far as the North and the East Rivers are concerned, as far as the Department of Health is concerned.

Q. Now, how is it with the ferry slips?

A. I have just mentioned that many of the sewers empty directly into ferry slips, and as a consequence the waters being more or less confined, are extremely offensive, so much so that in summer time the conditions are really serious. There is another matter that might be mentioned, along the shores of Manhattan and the Bronx, also of Brooklyn on the East River the deposit of decomposing material on the piles and on the docks on the shore fronts. These deposits occur at high tide, sometimes at very high tide, and they remain and flies accumulate more or less on them, gathering the filth on their feet and carrying that to foodstuffs in the neighboring markets or houses. There is no question but what a great deal of filth is carried to foods in just this way.

Q. Do you regard flies as a medium of infection?

A. There is no question but what flies carry typhoid fever in a great many cases. Just what proportion, it is very difficult to say, because there is a large proportion of typhoid fever cases, wherein you cannot find the cause, the actual transmitting agent.

Q. Are the odors offensive from these deposits that you speak of?

A. So far as Manhattan and the Bronx are concerned, not so offensive as some other parts of the city, but at times and in the neighborhood of sewers they are very offensive.

Q. How do they affect the oyster beds of the City or the oyster supply as to the oysters themselves, Doctor?

3320 Going back about 35 or 40 years ago, there were considerable oyster beds on Spuyten Duyvil Creek, and these oysters were esteemed a very great delicacy, a very excellent oyster. Those have gone out, become exhausted absolutely and entirely, because the waters have become so polluted that they no longer grow there. In some of the waters emptying into New York Bay directly or indirectly, for example the Rahway River, and for example the creek at Port Richmond, Staten Island, the oyster industry there has been practically killed, on account of the pollution of these streams, Princess Bay, which was formerly a very great center of the industry is diminishing, becoming less and less as time goes on, simply for the reason that the pollution of the water interferes with the growth of the oysters. In Jamaica Bay so far as the oysters are concerned, the waters are not sufficiently polluted to prevent their growth and they do grow and to all appearances, and to the taste they are wonderfully good oysters. There is no evidence whatever at the present time that the waters of Jamaica Bay are so polluted as to interfere with the healthfulness of the oyster in the beds. But, unfortunately it is the practice of the oystermen to take their shell fish from the beds and to keep them for a longer or shorter time, freshening them, as it is called, in various semi-brackish or brackish waters in the neighborhood of the oyster beds. These creeks are all more polluted than is the bay at large, and as a consequence, the oysters have not infrequently been infected by them. Within the last year there was an outbreak—not an epidemic, but an outbreak—of typhoid fever in one of the little towns of New York State, Goshen, which was traced undoubtedly to start with, to oysters, taken

3321 from the beds in Jamaica Bay and freshened in a creek outside the limits of the City of New York.

Q. What do you mean by freshened?

A. I mean taken out of their beds, carried up into the creeks that have a less salty content, than the waters of the Bay from which the oysters have been taken. In other words, there is a difference in the specific gravity of the water in which they are placed and the water from which they were taken. They take up the water in the freshening places very rapidly, and they become plump looking and more appetizing in appearance to certain people, and that has become a common factor and has developed in practically all the oyster industries in the country. There is a further reason for that, however. During a certain part of the oyster season, the waters over the oyster beds are so frozen in so that the oysters cannot be dredged up, and therefore have to be gotten up early in the season and stored in these floats in creeks for the demand during the Winter.

Q. Do the deposits from trade wastes affect these oysters as to their marketable quality or their properties for food?

A. The deposits from trade wastes undoubtedly affect the oysters in two ways. In the first place, they may give them a taste which will render them obnoxious so that there is no marketing them. On the other hand they may discolor them, and in the third place, the trade waste may be so great as to interfere with their *nutrition* and growth.

Q. Now, as to the trade wastes, taking Gravesend, Bay Ridge and Staten Island, that region, Doctor? As to the trade waste and pollution generally what do you say?

A. It has prohibited to a very large extent, the use of those beaches for bathing purposes. The waters are so contaminated that
3322 a person must have a little sense of decency to bathe in them.

They are covered with all sorts of floating material, and the bathing beaches not only have on them decomposing vegetable matter, but considerable quantities of fecal matter that has floated up on the tides.

Q. Does that give rise to any odors or deposits?

A. Gives rise to odors from the deposits on the shore, and not only that, but the deposits of fecal matter on the shores gives rise to infection by means of flies. We regard that as a very serious menace. We believe to a certainty that in many instances outbreaks which may not have started from flies in this way, have been kept up by flies alighting in fecal material, not necessarily becoming infected in that fecal material, but developing to such an extent, that they are in large numbers in certain localities, and so spreading the disease which started in some other manner.

Q. Do you believe that these deposits are harmful in this way?

A. I know they are. I have seen flies and maggots actually in these deposits. As a matter of interest, not as bearing on the question of harbor pollution, but as to showing how flies will develop in that material, in the case of an outbreak, we had very recently, in my practice in Bay Ridge, numbering about 200 cases we found a great many flies developing in this fecal material in the interior of houses that were being constructed, where the workmen had not proper facilities, and they would simply go from their work down into the

cellar and defecate, and the flies grew and developed and laid their eggs there and simply became very numerous in consequence. The same thing is certain to happen when that material is cast up on beaches and left in the hot sun.

3323 Q. In that way do you regard it as a menace to health?

A. I do, decidedly, sir.

Q. Is the sewage discharged into Jamaica Bay discharged in a crude state?

A. Yes, and no, Dr. O'Sullivan. There are four sewage disposal plants on the margins of Jamaica Bay that were built to take care of the sewage, and to so alter it that it would be at least innocuous, at least inoffensive. As a matter of fact the chemical examination and bacterial examination of the material after it has passed through these sewage disposal plants is very little better than the material that is brought to them. It simply means that the sewage is advancing in such tremendous bounds that it gets ahead of the plants that are constructed, and the plants are overloaded practically before they are finished.

Q. The resulting purification would amount to what?

A. I doubt very much if the purification amounts to 10 per cent. on the average in these particular plants. That is nothing against the plants, understand. That is not a criticism of the plant, it is simply a criticism of the amount of material that the plant does not care for. There is a great deal of material discharged into Jamaica Bay without passing through plants which have not room to pass it through either.

Q. What do you regard as the general effects of this sewage contamination?

— I think there are two effects. There certainly is occasional—there is disturbance to health by means of transmission of infectious diseases, that is the transmission of typhoid. That at the present time is the only disease that comes from the bowels and which is regularly transmitted from one person to another through the discharge from the bowels. If there were cholera, undoubtedly we would have cholera transmitted in the same way, so that flies developing in this material which is cast up on the beaches undoubtedly can transmit transmittable diseases in that way. In

3324 another way, a little more indirect is the effect from the odors, the nuisance from odors. A person who is exposed to offensive odors day after day, gradually loses his appetite, and as he loses his appetite, he loses his sustenance, and his general health suffers, and he becomes a prey to any contagious disease that ordinarily he was not susceptible to, and in that way I think it is a very serious menace to health. Aside from that there are many people who are simply exposed occasionally to the offensive odors, and while their general health may not suffer, nevertheless they should be protected from that nuisance.

Q. Exposure to these noxious odors, do you regard that as in any way interfering with the vital resistance of people, to the encroachment of disease?

A. I do in that way, in the way of interfering with their suste-

nance, interfering with the appetite, so that they do not get the proper quantity of food. It is stated and believed by many people that the breathing of some of these gases, instead of breathing the normal content of oxygen, pure atmosphere, may affect the health also. As to how far that does affect health, in my mind I am not sure, in the open air. I know in houses of course and any confined atmosphere, it does have an effect, but I think that other more important, the disturbance of digestion and appetite, simply resulting from offensive odors, constantly breathing them.

Q. Do any symptoms that you know of follow in the wake of inhaling these putrescent gases, such as nausea, headache, symptoms of that kind?

A. Nausea, lack of appetite, disturbance of the bowels, depression and headache and a tired sort of feeling are very very common among people exposed to them.

Q. Are you familiar with the conditions at Newtown Creek?

A. Very. Hardly a day goes by but what I have complaints concerning the obnoxious odors in and around Newtown Creek, 3325 and I may say that these odors are due to the discharge of trade wastes into the creek. There are very few dwellings in the neighborhood and the offensive conditions I feel are largely responsible for the lack of dwellings and the lack of people living in the neighborhood. They cannot stand it. Newtown Creek is in effect an enormously large sewer, nothing more and nothing less and decomposition has practically given place entirely to putrefaction.

Q. Do you regard that as the result of anaerobic action?

A. Entirely to anaerobic action. There is so much material to decompose that there is not oxygen enough to allow of ordinary decomposition, and it simply takes place in the absence of oxygen and by means of the anaerobic bacteria.

Q. What results would you apprehend as a sanitarian from the volume of sewage proposed to be discharged through the Passaic Valley trunk sewer outfall into New York upper Bay?

Mr. Riker: The question is objected to as it does not appear that this witness has any knowledge with respect to the matter in question.

The Commissioner: Note the objection of Counsel for Defendants.

A. We would simply have a steadily increasing amount of decomposable material. Eventually we would have such an amount that the conditions on the Newtown Creek would practically repeat themselves.

Q. On a larger scale?

A. On a tremendously large scale. There would be so much material that the amount of oxygen contained in the waters at present that can be used for that purpose would be unable to produce ordinary decomposition and putrefaction would take place, if not entirely, to a large extent and tremendous offence would arise.

3326 Q. Would you expect a nuisance to arise from the conditions?

A. A nuisance in that way, a further nuisance of deposit, more or less of solid material on the shores of the bays, harbors and rivers.

Q. Would coarse screening and sedimentation in your opinion remove the possibility of such offensive conditions?

A. The very best kind of screening under the most scientific supervision would probably remove in the neighborhood of 10 to 15 per cent. Beyond that, it probably would not affect it. That has been the experience of other cities that have resorted to screening as a method of purification.

Mr. O'Sullivan: Your witness.

Cross-examination by Mr. Riker:

Q. Doctor, you were asked about the discharge of the proposed Passaic Valley Sewer and have expressed an opinion as to what it would eventually do? Do you mean by that testimony that the Passaic Valley Sewer discharge itself would produce this tremendous nuisance that you have testified to?

A. It would simply add to the already existing conditions. I do not mean that it in itself, and alone by itself, would produce this nuisance.

Q. Then if your testimony on the direct was to the effect that it would produce that result, you do not mean it?

A. Yes, it would add to the existing conditions so as to produce the result.

Q. I ask you whether the discharge itself and by itself would produce this tremendous nuisance that you testified to?

A. Alone by itself.

Q. Yes.

A. No, sir.

Q. Would it produce any nuisance by itself?

A. It would.

3327 Q. In what respect?

A. Exactly in the same respect as described for those already in existence.

Q. Where would it be discernible?

A. Wherever it discharged into New York Harbor.

Q. How would it be discernible?

A. In materials that would be cast up on the beaches at high tide and left to decompose and materials that would stay in the water, decompose or putrefy in the water.

Q. What is the character of the discharge that you have in mind that will produce these results?

A. The ordinary character of sewage containing trade waste, decomposable material and containing large quantities of animal excreta.

Q. And do you contemplate any treatment of this sewage before it is discharged?

A. I have already understood that it is to be treated by screening and sedimentation without chemical action.

Q. That is your understanding?

A. That is my understanding, yes.

Q. Do you understand what character of effluent is guaranteed

to be produced by the stipulations made by the State of New Jersey and the United States Government?

A. I do not.

Q. You do not know anything about that?

A. No.

Q. Do not you think you are a little bit rash to testify without knowing that?

A. Only two things, be treated, as the question asked, by sedimentation and by screening.

Q. I think the question was what the proposed discharge would result in, and it appears that you do not know what the discharge is?

A. There is not any discharge at the present time.

Q. I said the proposed discharge and not the present discharge.

3328 Now, kindly pay attention to the question and answer it. Don't you think that you are rash in testifying to a proposed discharge when you do not know what it is proposed to do?

A. No, I do not, because I have a knowledge of sewage disposal plants and have a knowledge of how they work.

Q. Have you a knowledge of whether or not an effluent can be produced, that will not cause a nuisance?

A. I know it can be.

Q. Do you know whether that is or is not the effluent that is guaranteed to be produced by the Commissioners in the stipulation made between the State of New Jersey and the United States?

A. I know this—

Q. Will you answer the questions please?

A. I do not know what the guarantee is.

Q. Are you familiar with the recreation piers of the City of New York?

A. Very.

Q. Where are they located?

A. One at 24th Street, Borough of Manhattan, one in the neighborhood of 100th Street, Borough of Manhattan, one in the neighborhood of 129th Street, Borough of Manhattan, one I think it is 50th Street, Borough of Manhattan,—those are the ones I am most familiar with.

Q. Take the 24th Street recreation pier. How near is that to a sewer outlet?

A. I do not know where the nearest sewer is.

Q. Have you not observed the conditions about the public recreation piers?

A. There is nothing about the recreation piers which would interfere with the health of people on that pier.

Q. I asked you whether you had investigated?

A. I have observed the conditions.

Q. What are the conditions in the slips of the Pennsylvania Railroad adjoining the recreation pier at 24th Street?

3329 A. So far as the health of those using the recreation pier is concerned, very good.

Q. I ask you what are the conditions of the water as to pollution?

2289

A. Polluted. It is polluted.

Q. Now you have said there were five public baths maintained this summer off the Manhattan shore?

A. Six, I said.

Q. Six.

A. Two of them are at the Battery, two of them on the North River front and three on the East River front. They have been placed in various places trying to get some place that was not at all offensive. We regarded, I might say, we regarded the placing of public baths anywhere along the North or East River front as impracticable, and the question of whether they are placed in one place or another had little to do with our action of this summer.

Q. You have taken a chance in other words?

A. We are taking a chance.

Q. How far from the shore front are they placed?

A. Some of them next to the bulkheads, some near to the ends of the piers, depending upon the outlet of the sewers in the neighborhood of the individual bath.

Q. Have they or have they not been located during the summer within the polluted area?

A. They have.

Q. Polluted by untreated, crude, raw, fresh sewage?

A. Yes.

Q. How does the condition of the baths at those baths in your opinion as an expert compare with the conditions of the bathing beaches that you have testified to?

A. Which bathing beaches?

Q. What bathing beaches have you testified to?

A. On the Gravesend Bay, Bay Ridge.

3330 Q. The ones that you testified to, Doctor?

A. The waters in which they are situated are more polluted than they are at the bathing beaches.

Q. Are you familiar with the condition of the beaches along the ocean front in the vicinity of places where the New York garbage scows dump their loads?

A. I do not know that I quite understand your question, as to where the scows dump their loads. They dump them on the shores of Barren island.

Q. Do you remember when they used to discharge them at sea?

A. Used to discharge them at sea—only the quantity of garbage that happened to be mixed with ashes. These scows have not been dumped at sea for a great many years.

Q. How many years?

A. Well, it is 12 or 15 years certainly since garbage has been dumped at sea.

Q. Did you ever visit the beach at Long Beach and Arverne before that period?

A. Yes, I have.

Q. Have you seen the mottled assemblage?

A. I know the conditions very well, have seen them many times.

Q. Have you seen the water filths, the municipal filths and all sorts of garbage along the shores?

A. That cannot be attributed to the dumping of garbage scows. A great deal of that comes from passing steamships.

Q. It is very offensive?

A. In hot weather, yes, very offensive.

Q. Are you familiar with the Jersey shore at Long Branch, along there?

A. Yes.

Q. Have you seen the accumulation of material along those shores?

A. Prior to this dumping at sea, yes.

Q. Now, on the beaches that you have testified to on your direct examination, what part of the objectionable matter that was
3331 present, what part was garbage and what part was sewage, was any part garbage?

A. Yes, undoubtedly a large part of it was garbage, undoubtedly.

Q. Are you aware of the fact that Jamaica Bay oysters have been condemned by the United States Government?

A. They have not been condemned by the United States Government. I am not referring to any newspaper report, but they have not been condemned by the United States Government.

Q. You know that, do you?

A. I do. As soon as the United States Government condemns them, they will not be allowed to be shipped from one state to another. That has not happened so far as to the Jamaica oysters as yet.

Q. Your judgment is that the oysters from Jamaica Bay are a fit food product?

A. Yes, and I know some of them are not a fit food product, particularly after they have been taken from the oyster beds and put in waters which do not produce a fit food product.

Q. As taken from the waters of Jamaica Bay, as they come from the waters of Jamaica Bay, do you think they are a fit food product?

A. From some, yes, from some, no, depending entirely on the depth of the water, the amount of the tide, the amount of flow and the amount of contamination of the water over them.

Q. And the amount of contamination in the water over them, does that in your judgment depend upon the proximity of local
sewers?

A. Very largely, yes.

Mr. Riker: That is all.

Mr. O'Sullivan: I think that is all, Doctor.

3332 THEODORE HORTON, a witness called on behalf of Complainants, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your profession, Mr. Horton.

A. Sanitary Engineer.

Q. Are you connected with any of the state departments?

A. The State Department of Health.

Q. In what capacity, what official capacity?

A. As Consulting and Chief Engineer.

Q. Where did you pursue your studies in engineering?

A. At the Massachusetts Institute of Technology.

Q. When did you graduate?

A. 1894.

Q. Just state your experience since then, Mr. Horton?

A. May, 1894, to June, 1895, sanitary Engineer and Agent for Montclair Board of Health, Montclair, New Jersey, on work of reorganizing and framing of general health and plumbing ordinances, inspection and testing of all plumbing; investigation of the pollution of all streams traversing the towns; inspection of all dairies supplying milk to Montclair; inspection of all nuisances; design and construction of a small plant for the disposal of cess pool matter; study of method of night soil and garbage disposal; investigation and report upon the cause of a typhoid epidemic in Montclair; study of vital statistics of Montclair and surrounding towns, chemical analysis of some 60 well and public water supplies in laboratory furnished by the board.

June, 1895, to October, 1895: Assistant Engineer on street and road construction in Bureau of Local Improvements, Brooklyn, New York. This position was obtained through competitive civil service examination. During this period also passed successfully (with rank No. 2) civil service examination for general inspector of granite pavements.

3333 October, 1895, to April, 1896: Assistant in Engineering Department of Massachusetts State Board of Health; on sanitary inspection of the water sheds of new water supplies of the State; calculations for determining the yield and storage in connection with same supplies; hydraulic calculations relative to the new sewerage systems of the State; on the special study of the improvement of the Neponset meadows (including two cases of water power damages based upon the methods of the Metropolitan Water Board); hydraulic field observations of flow of various streams in relation to the yield of watersheds; other miscellaneous studies and calculations.

April, 1896, to August, 1901: With Metropolitan Sewerage Commission as outlined below—From April, 1896, to May, 1898, Assistant on maintenance studies and day work construction; two series hydraulic experiments upon the flow in the Metropolitan sewers, yearly studies relative to tributary areas, flows, per capita rates, leakage, etc., in charge of pumping station records, involving daily calculations of quantities pumped, coal, lifts, duties, etc., monthly observations of losses of head in all the syphons of the North Metropolitan system; in charge of the tide gauges, records, and various tidal studies, calculations of monthly observations of flow from the various cities and towns of the Metropolitan district—

Q. What Metropolitan District was that?

A. The Boston Metropolitan District.—Preliminary surveys and contract plans of sections 53 and 55 of the North Metropolitan Sy-

tem; lines and grades for a new coal pocket at the Alewife Brook Pumping station; also lines and grades and calculations for various retaining walls and embankments, rip-rap, regulators, pumps, etc.

3334 May, 1898, to June, 1899: Principal in charge of lines and grades for additional pumping plant at the four pumping stations for the commission (including pump-wells, suction and discharge channels, engine and boiler foundations, reservoirs, etc. ;) special hydraulic studies and calculations connected with the North Metropolitan and Charles River systems;

June, 1899, to Sept., 1900: Assistant Engineer in charge of special hydraulic studies and calculations connected with the High-Level Sewer. Have submitted some 20 special studies and reports upon various hydraulic and structural features connected with the High-Level System, the more important of which are the following:

1. Design and study of anticipated losses of head for the various periods of High-Level Sewer crossing under Stony Brook, Neponset River, Roslindale Brook and depressed section in Hyde Park (6 reports).

2. A study of the reversion of grade of the lower portion of the Charles River system and proposed suction sewer to the Ward Street pumping station with resultant hydraulic conditions for future periods.

3. A study of the bearing power of the soils in the vicinity of the proposed Ward Street pumping station.

4. A study for an auxiliary water supply for condensing purposes for the Ward Street pumping station.

5. A set of piezometer experiments upon losses in the suction and discharge channels of the new pumping plant of the Alewife Brook pumping station.

6. Design and study of hydraulic conditions for culverts for seven tidal areas to be impounded by embankment of High-Level Sewer in Quincy.

7. Study of the flood discharges and resultant scouring velocities of Stony Brook at the point of the crossing of the High-Level Sewer.

8. Study of the hydraulic conditions in the two proposed force mains leading from the new Ward street pumping station under the varying conditions of discharges and manipulations of pumps.

9. Report upon three series of current meter observations made in the sewers of the North Metropolitan System.

10. Design of two brook crossings (in Chelsea and Melrose) on extensions of the North Metropolitan System.

11. Study of hydraulic conditions which will obtain in the two outfall mains of the High-level area under varying conditions of discharges and tides.

12. Various reports upon some 25 efficiency and duty trials to study the improvements of the new Blake centrifugal pumping plant installed at the Alewife Brook pumping station.

September, 1900, to August, 1901: Assistant Engineer in charge of special hydraulic studies and calculations connected with the Metropolitan Sewerage System, and in charge of maintenance of the

North Metropolitan System. The more important work during this interval has been as follows:

1. In charge of the official duty and capacity trials of the additional pumping plants installed at the four main line pumping stations (three triple-expansion Corliss engines and centrifugal pumps of 60,000,000 gallons capacity, and one Blake compound engine and pump of 13,000,000 gallons capacity).

2. In charge of all maintenance work previously classified under my experience to May, 1899.

3. A final study of ground-water leakage of the local systems of the Metropolitan districts and eastern Massachusetts.

3336 4. Earth pressure studies of two retaining walls on line of High-Level Sewer.

5. Study of valuation of Blake pumping plant at Alewife Brook pumping station (not up to contract requirements).

6. Equilibrium study of 150 foot chimney and foundation of Ward Street pumping station.

7. Design of 100 foot chimney with foundation for Nut Island screen house.

8. Earth pressure study of all, and special designs of four, foundation walls of Ward Street pumping station, screen house, etc.

9. Study of probable ground water yield at points on High-Level Sewer.

10. Design for siphon to replace present Mystic Valley Sewer under Abbajona River.

11. Preliminary studies for sizes and sewer routes for various areas of the Metropolitan Sewerage District.

12. Some 20 other studies of reports of minor importance.

August 1901 to date: With Hering & Fuller, Consulting Engineers, as follows:

August 1901 to May 1904: Principal Assistant Engineer in charge of general office work (and occasional field work) in preparing plans, specifications, estimates of cost and assisting on reports for water supplies, sewerage systems, sewage disposal, water power, garbage disposal, pump testing, etc. This work includes principally, sewerage systems for Sacramento, California, Trenton, N. J., Morristown, N. J., Portland, Me., South Nyack, N. Y., Red Bank, N. J., Manzanillo, Mexico, Fort Totten, N. Y., Galesburg, Ill., York, Pa., Ferncliffe, New York, Atlanta, Georgia, Trenton, New Jersey, Lexington, Kentucky, Water Supplies of Hackensack, New Jersey;

3337 Water Company, Fort Totten, New York, Ferncliffe, New York, Meadville, Pa., Manzanillo, Mexico and Columbia, Pa., also studies connected with water supplies of Brooklyn, N. Y., New Orleans, Louisiana, New Haven, Connecticut, Springfield, Massachusetts, hydrographic studies of Mississippi, Missouri and Illinois Rivers in connection with Chicago Drainage Canal; hydraulic studies connected with Charles River Dam Boston, Mass.; designs and preparation of plans and estimates of cost for the Passaic Valley Trunk sewer under the two last Commissions: (See Report of Passaic Valley Commissioners, about 1902) in charge of official duty trials of pumps of Meadville, Pa., and Columbia, Pa. Water Works.

May 1904 to August 1904: Engaged by Town of Montclair, N. J., in preparing plans and report upon system of storm water drainage system.

August 1904 to August 1906: Resident Engineer for Hering & Fuller in charge of construction of York, Pa., Sewerage System; construction of dam, roof and lining for Reservoir of Columbia, Pa. Water Company, and landscape development of tract of land about 100 acres owned by P. A. & S. Small Land Company, York, Pa. During this period was employed by Pennsylvania State Department of Health on investigations reports and preparation of plans for collection and disposal of sewage of Harrisburg, Pa., and on other sanitary engineering investigations and reports.

August 1906 to date (August 1911): Consulting Engineer to New York State Department of Health as Chief of Sanitary Engineering Division and Director of the Sanitary Engineering work of the Department, including investigations, reports, and advice concerning engineering matters relating to Public water supplies, public sewerage systems, water purification, sewage disposal, stream pollution, public nuisances, garbage disposal, typhoid fever investigations and other matters relating to public health and sanitation.

References are given to the following publications of the writer:

No. 1. A report in the "First Annual Report of the Montclair Board of Health."

No. 2. "Investigation of a typhoid epidemic in Montclair, N. J.," published in the Medical Record for October, 24, 1894.

No. 3. "A form of Mass Diagram for determining the yield of watersheds" published in the Engineering Record for July 31, 1897.

No. 4. "Hydraulic Diagrams for the Discharge of conduits and Canals," by Charles H. Swan and Theodore Horton, published by the Engineering News Publishing Company, New York.

No. 5. "Flow in the sewers of the North Metropolitan Sewerage System", published in transactions of the American Society of Civil Engineers Vol. XLVI.

No. 6. Discussions on "Garbage disposal", Trans. Am. Soc. C. E. Vol. L.

No. 7. Discussions on "Centrifugal pumps" Trans. Am. Soc. C. E. Vol. LI.

Published reports and addresses in the Annual Reports of the New York State Department of Health for 1906, 1907, 1908, 1909 and 1910.

Q. Mr. Horton, what special official connection and experience with the studies and reports of the Passaic Valley Sewerage & Drainage Commission have you had?

Mr. Riker: What is the name of that commission—I do not know of any such body in New Jersey.

The Witness: It is the official title some ten years ago. It took "drainage" in with it.

3339 Mr. Riker: All right; go ahead.

A. About the year 1900, if I remember correctly.

Mr. Riker: One moment, however, I desire to object to the question as being immaterial and irrelevant to the issue.

The Commissioner: Note the objection of Counsel for Defendants.

A. During the first and second commissions 1900 or 1901, as Assistant Engineer for the firm of Rudolph Hering and Geo. W. Fuller, I was in charge of the designs for the Passaic Valley Trunk Sewer, which was being developed, under those two commissions. The second commission, in 1901, I think it was, I had charge of the designs at the time that Mr. Fuller had charge of the field work. That was all reported in the reports of those two commissions.

Q. Have you inspected and studied the conditions in New York Harbor waters with reference to the Passaic Valley Trunk sewer project?

A. I did very particularly about that period, during those studies and investigations. Since that time I have incidentally done so in work incidental to the department and during my frequent visits in the vicinity. More especially at the time of the investigations of the smoke nuisances on Constable Hook when I was continually passing through these waters, New York Bay and around the Kill van Kull and the harbor in general.

Q. What inspections did you make of the Passaic River and Newark Bay?

A. I made inspections of Newark Bay and the Passaic River particularly during the times when I was studying the Passaic Valley project, when I was connected with the firm of Hering & Fuller around 1900 or 1901. Since that time I have not made a special study of the Passaic River, although I have passed it on one or two occasions incidentally and have observed the conditions.

3340 Q. What inspections have you made of the shores of the waters of New York Harbor and vicinity since say 1910 incidental to your work as an official in the Department of Health, the State Department of Health?

A. By frequently coming to New York City, and in some cases with special reference to sanitary investigations. One I referred to just previously, the Constable Hook investigation, which incidentally afforded an opportunity for very careful observations of the conditions in the harbor. I passed in boats and I was out in a boat very frequently on Constable Hook, Staten Island, the lower part of New York and at other times I have observed along the water front the conditions of the harbor, the pollution of it.

Q. Now, what studies have you made in New York Harbor and its tributaries since 1902?

A. I have made studies with special reference to certain sanitary projects such as the Bronx Valley Sewer. At that time I made a very detailed study of the general conditions around New York and of the pollution of New York Harbor and the Hudson River and incidentally the Bronx River, which was involved in this investigation. A lengthy report of mine is published in regard to that in the annual report of the State Department of Health 1900 and—I cannot give you the year—about the time that it was first approved by the Commissioner and the State Engineer.

Q. Have you made any oyster investigations?

A. In 1908 I was in charge of the field work, examination of the oysters of the waters of Long Island, including New York Bay, Jamaica Bay and Long Island, also including the waters adjacent to Staten Island. Since that time, this present year, I have continued studies or rather been engaged in continuous studies of the pollution of shell fish in these same waters but more particularly with reference to Jamaica Bay.

3341 Q. Have you conducted any investigations relative to the Passaic Valley Sewers at any time?

A. At the time of my connection with the firm of Herin & Fuller when they were working upon this project, the project of the first two commissions in 1900, which of course is preliminary, but not very different from the complete project as it now stands, I made numerous studies working for practically—a considerable portion of two years on the project. Since that time I have made no special study of the Passaic Valley project, except as it was incidental to questions that have been submitted to the State Department of Health, to the commissioners, as I say, incidental studies in connection with the questions which have arisen in connection with the department.

Q. Now, relative to the literature on this subject, Have you studied the Passaic Valley Sewerage Commissioners reports?

A. I have read them, yes, sir.

Q. The New York Bay Pollution Commissioners' Report?

A. I have read practically all of them.

Q. And the Metropolitan Sewerage Commission's Reports?

A. I have done them also.

Q. Now, from these inspections and studies of New York Harbor and its tributaries, and the Passaic River and the Newark Bay, what conclusions do you draw relative to the harbor and its tributaries in the vicinity of New Jersey?

Mr. Riker: The question is objected to on the ground that it is in effect a hypothetical question based upon matters which are not in evidence in this cause and not matters of proof, and that the question is not in proper form as a hypothetical question.

The Commissioner: Note the objection of Counsel for Defendants.

3342 A. The question refers to the present pollution?

Q. Yes.

A. My conclusions as to the present conditions of the harbor are that there are numerous local nuisances, and that the harbor in general is beginning to approach a state of general nuisance arising from odors floating coarse and suspended sewage matters, grease, discoloration, deposits of sewage mud. The diminution of the digested capacity, due to the exhaustion by the domestic sewage discharged into it, the reduction in the dissolved oxygen, which is now very much depleted, and which if it is not checked will ultimately and presumably in the near future be entirely exhausted, or be so largely exhausted as to create a general nuisance.

Q. Have you studied the Passaic Valley Trunk Sewer project itself, Mr. Horton?

A. I have.

Q. State what your studies consisted in?

A. Very specifically the entire project in the years 1900—in 1902, when I was in charge of the design of the Passaic Valley Trunk Sewer. Subsequent to that time I have followed it in the reports of the Passaic Valley Trunk Sewer Commission and the Metropolitan Sewerage Commission reports and I have seen the plans of the commission as to what the project comprises. I have also studied it in connection with the Bay Pollution Commission and the Metropolitan Sewerage Commission.

Q. Have you reached any conclusion as to the result and efficiency of the project?

Mr. Riker: The question is objected to on the ground that the efficiency of the plant as such is not an issue in this case.

The Commissioner: Note the objection of Counsel for Defendants.

A. My conclusion is that the plant as proposed, and as I
3343 understand it is to be from the plans which I have seen, is of considerably low efficiency. The screens and sedimentation basins will remove but a small portion of suspended and objectionable matter, probably not over 5 to 10 per cent. of the total, and probably not over 10 to 15 per cent. of the organic matters. It will remove only a small portion of the grease.

Q. Now from your studies of the Passaic Valley Trunk Sewer project, what results would you expect to follow its operation and the discharge of the sewage as proposed into New York Upper Bay.

Mr. Riker: The question is objected to because it does not yet appear that this witness knows what the character of the sewage is that is proposed to be discharged into the Bay.

The Commissioner: Note the objection of Counsel for Defendants.

Q. You may proceed?

A. It is my opinion that a local nuisance will be produced in the vicinity of the outlet, and a general nuisance for a considerable distance from the proposed outlet, due to suspended matters, grease and sleek and discoloration, a sewage treated as it is proposed to be treated, will cause deposits which will slowly accumulate in many parts of the harbor, more particularly in the vicinity of the outlet. It will deplete the dissolved oxygen and will destroy—will damage the water for shipping, shipping and industrial purposes. It will blacken the paint on vessels and interfere with pleasure uses of the water such as boating and fishing, and will interfere with the fish life. It will endanger health first directly through the bathing beaches, infecting the bathing beaches and floating baths, or through infections received at these places. It will also affect the fishing and boating and the shell fish pollution. Drift wood which has
3344 been gathered in the waters or from the waters which have touched or floated in the waters nearby this pollution, and there will be danger to health from the exposed shores and wharves

through the medium of fly transmission. There will be danger from the use of water used for washing boats, where this water is taken from portions of the harbor and bay where the pollution will reach. There will be danger from the dredging operations, which will cause this mud to be brought more into suspension, and sometimes brought out upon the surface, where it may become a source of infection. Indirectly there will be a danger to health due to the depression of the human system and the lowering of vitality or vital resistance of people who are subjected to the odors, or who are in the vicinity of the water- that have been grossly polluted by the sewage. These odors and the general obnoxious appearance and offensive conditions will depress the human system and lower the vital resistance to the attack of disease germs. This is of course a secondary danger or menace to the health.

Q. Have you studied the stipulations entered into by and between the United States and the State of New Jersey and the Passaic Valley Sewerage Commission?

A. I have.

Q. Will you state what you find the practicability of its enforcement and its effectiveness to be—

Mr. Riker: The question is objected to on the ground that the witness is not an expert as to the practicability of the enforcement of a legal document.

The Commissioner: Note the objection of Counsel for defendants.

A. From an engineering standpoint?

Mr. Riker: The question is objected to when it contains
3345 that addition on the ground that it is not a question of practicability at all. It is a question of the legal effect of the instrument.

The Commissioner: Note the objection of Counsel for Defendants.

A. I am of the opinion that the works guaranteed in the stipulation One would not accomplish the results guaranteed in stipulation Two. At least only partially so. In expressing this opinion more specifically, I will say first with reference to the section where it is stated that there will be an absence in New York Bay of suspended particles, it is my opinion that the tanks and the screens will remove only a portion of the suspended matters. The remainder will be plainly visible in the vicinity of the outlet and for a considerable distance from it.

The stipulation stating that there will be absence of deposits objectionable to the Secretary of War, although I do not know what the Secretary of War may think—what objection he may have to it, in regard to there being deposits, this will not be accomplished and there will be considerable suspended matter which is heavier or will become heavier than the harbor water. These will be carried to distant points or settle at near points where the velocity is checked, some settling near the outfall and others at distant shores or quiescent parts of the harbor. When once settled, they will remain there probably with less tendency to be carried again in suspension. In other

words the power of the velocities must be much faster than the depositing velocities in order to start a particle in motion which had once become settled.

With reference to the stipulation which states that there will be absence in New York Bay and vicinity of odors due to the
3346 putrefaction, this will not be accomplished. The sewage will be stale or septic when it reaches the outlet. Under ordinary conditions and generally during summer months, these odors will be detected in the vicinity of the outfall. Under unfavorable conditions, moreover, warmer seasons, slack waters, quiet atmosphere and high humidity, these odors may be detected for considerable distances from the outfall.

With reference to the practical absence on the surface of New York Bay of grease and color, this will not be accomplished. There will be a zone of marked discoloration in the immediate vicinity of the dispersion area which may extend to considerable distances from it. The proposed works will not remove all grease and as a result sleek will be plainly visible, especially with quiet atmosphere, for considerable distances from the outfall.

With reference to the stipulation that there will be no injury to the public health and no public or private nuisance, this will not be accomplished. In regard to the public health the sewage discharged will contain infectious material which will be carried to distant waters and shores. This infected material will cause danger to health by affecting the bathing beaches, boating and fishing, shell fish, driftwood, dredging operations, and through the medium of flies, that may be on the exposed shores and docks and through the medium of water that may be used for deck and other purposes in ships. A nuisance will be produced at the outlet or elsewhere affecting yachtmen, ferry boat passengers, fishermen, and industrial concerns, which will result from odors, discoloration of the water, suspended and floating matters, sleek and grease, deposits and the blackening of paint.

With reference to absence in reduction of the dissolved oxygen to such an extent as to interfere with major fish life, this is of course indeterminable. There is no specification as to what
3347 is major fish life; furthermore we do not know the effect of the exhaustion of dissolved oxygen on fish life, that is, definitely and scientifically. The inference is, however, that there is a possibility that, although this may not affect what may be termed major fish life, it may affect largely minor fish life.

Q. Mr. Horton, how far will the fulfillment of the conditions or specifications under this second item in the stipulation protect the State of New York?

A. The stipulations, assuming them to be fulfilled, the four following stipulations in my opinion, would fairly satisfactorily protect the State of New York. That there will be absence of visible suspended particles and so forth; that there will be absence of odors and so forth; that there will be absence of color and grease and so forth; that there will be no injury to the public health. The other specifications would be less satisfactory. That is, the absence of

deposits objectionable to the Secretary of War, and there is no guarantee to New York State against objectionable deposits. There might also be other objections to New York State than those objectionable to the United States. It is my understanding that deposits affecting the United States would probably be confined to the main channel and with less reference to sanitation, whereas these deposits that would be more vital to the State of New York might occur outside of the channel of the harbor and bay in shallow places and thus materially affect the comfort and health of the people of New York, first, through infection or menace or danger to the oyster industry, and nuisances which may arise from septic action, and filling up shallow places, the deposits being more likely to fill these places, than the channels. Here, deposits may occur from these suspended materials delivered from the sewage.

Q. Now, as to the absence of injurious effects on the property of the United States, how would that insure absence of injury
3348 to the property of the citizens of the State of New York,

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of Counsel for Defendants.

A. There is no guarantee to the State of New York.

Mr. Riker: I object to the opinion of this witness as to the legal effect of the instrument.

Mr. O'Sullivan: I am inquiring, Mr. Riker, as to the facts.

Mr. Riker: I am putting my objections to your questions on the record, that is all.

Q. You may proceed?

A. There is no guarantee to the State of New York with regard to any damage to it, in this respect. This provision suggests the possibility of certain damages not provided for in sections of the stipulation which might affect New York State, such as the injury to paint, the use of water for deck purposes, for washing decks and the use of the water for incidental purposes such as condenser water, ice refrigeration and cooling purposes, fish cleaning purposes and so forth. There also may be a deleterious effect on the corrosion of iron and from the acids or chemicals that may be in the sewage and the trade waste, which are mixed with it.

The other stipulations which would be unsatisfactory would be the absence of reduction of dissolved oxygen, as to its interference with major fish life. This test in my opinion is a useless one to protect the interests of New York State. Major fish life is not defined. We do not know the effect of sewage on such life sufficiently well or definitely to use it as an index of damage from pollution. There is no way of telling statistically or otherwise whether interference with fish life, in the cases used as criteria were due
3349 to deficient supply of oxygen or other causes. We could not trace definitely any deteriorating effect of the Passaic Valley sewers in distinction or counter distinction from other sewer

pollution in New York Harbor, and we might have offensive conditions near the outfall, but when the sewage is dispersed and diluted the oxygen content might not be reduced so low as to interfere with such life. Furthermore, there is no guarantee that minor fish life would not be affected. If it were, then this will be one more injury to waters of the harbor, due to the Passaic Valley project.

Q. As to the practicability of proving any of these injuries, as an engineer what is your conclusion in that respect relative to the stipulations.

Mr. Riker: The question is objected to on the ground that it is not a matter of injury as to whether or not the violation of the stipulation with the United States can be proved or not. It is only what is the expressed intention of the State of New Jersey and the Passaic Valley sewerage Commissioners for carrying it out.

The Commissioner: Note the objection of Counsel for Defendants.

A. It is my opinion that some of the provisions are partially enforceable, such as numbers 1 and 2, 1—that there will be absence in New York Bay of visible suspended particles, and 2, that there will be practical absence on the surface of the water, of any grease or color and so forth. That is the pollution will be so intense at or near the dispersion field generally, as to show unmistakably the source of the trouble by contrast with other and less polluted waters adjacent. At other places, however, these conditions would
3350 be so apparent by contrast, that differentiation would be more difficult, if not impossible.

Other provisions, such as 2 and 6, are unsatisfactory to the State of New York in regard to the enforcement, on the ground that New York State is neither a party or a judge in reference to those stipulations, owing to the provision in the contract stating that the Secretary of War is the sole judge and he would have the same difficulty to substantiate his position, if the conditions were decided by him to be objectionable. The Secretary of War would find it impossible to indentify the Passaic Valley sewage or the cause of the deposits and injurious effects. These deposits would be slow and progressive and due partly to other causes and hence it would be difficult to differentiate it from the other factors.

Further, the State of New York is given no access to the works or outlet, to the purification works or the outlets, or opportunity to determine as to the fulfillment or occurrence of the damages or objectionable conditions which may affect the United States Government.

The remaining provisions, 3, 5, and 7, are practically unenforceable. First with respect to the nuisance from odors, for, although odors directly over the dispersion area might be so strong as to preclude any question as to their source, these odors might be less intense at other points more distant, where it might be difficult to fasten responsibility upon the Passaic Valley Sewer, on account of the pollution from other sources, and the overshadowing of these

odors, from other sources, such as the plants at Constable Hook. They would be unenforceable owing to the difficulty or indefiniteness of the term "putrefaction of organic matter." We have no accepted meaning of the term, that is, scientific meaning. There might be odors due to other matters, such as manufacturing wastes, gas and tar wastes and so forth mixed with the sewage.

3351 With respect to the injury to health, the danger will be largely remote, through the effect on bathing, shell fish, drift wood, washing decks with the water and so forth. The dangers are of a nature difficult to prove by statistics and the channels of infection are difficult to trace though we know they exist, such as from oyster epidemics of typhoid fever, epidemics of eye diseases among children who use the swimming pools; general principles and isolation of disease germs from water; transmission from handling and digging oysters; studies of fly transmission due to the sewage pollution and the general principles of disease transmission, and by analogy. Again, being at a distance, it is absolutely impossible to identify the dangers, as due to the Passaic Valley sewer. There are other sewers of course, discharging sewage, and they have a tendency to overshadow the effects of the Passaic Valley sewer and make it thus more difficult to differentiate.

Q. Now, as to the test applied to the reduction of dissolved oxygen relative to major fish life, have you considered that, and if so, state what your conclusions are relative to that portion of the stipulation?

A. That is relatively unenforceable on the ground that the term "major fish life" is indefinite. We know little about the effect of dissolved oxygen on fish life, and it is impracticable to prove that diseases or injury to fish life are due to lack of dissolved oxygen, or whether they are due to some other cause.

Other sections of the contract or stipulation are equally objectionable, in so far as there is no opportunity to inspect the outfall works. This is important in my opinion, in order to determine how far, so far as it is possible to do it, the provisions of the contract are being fulfilled.

3352 Mr. Riker: I move to strike that testimony out as the instrument speaks for itself, and the statement of the witness is directly contrary to the instrument itself.

The Commissioner: Note the motion of Counsel for Defendants.

Q. Proceed.

A. This is important also to secure information to be used as the basis of complaint or appeal to or from the Secretary of War.

Mr. Riker: I suggest, Doctor, that your witness examine this stipulation before he goes on record as to the contents of this instrument. It is an unwise thing for him to do, to swear to that, because it is not so. It provides that the United States Government shall have an inspector there all the time.

Mr. O'Sullivan: In the stipulation?

Mr. Riker: It certainly does.

The Witness: I stated that this was important in order that we

may determine the fulfillment of the provisions of the contract; that we may secure information as a basis for that, to use as a basis of complaint or appeal to or from the decision of the Secretary of War, and to observe the variations and progressive changes in conditions from year to year that will take place in the harbor waters due to the discharge of the sewage into it.

Furthermore, since the Secretary of War appears to be the principal judge in this stipulation, at least the only party interested, or in sympathy with the State of New York's interest, there is no guarantee first that he would be interested in matters which the State of New York is most interested in, and secondly that his standards would be at all satisfactory to the People of New York, or in their opinion, to their best interests. Thirdly, that he could or would determine the effective fulfillment of this contract. Fourth, that

even if he did decide that additional lawful works were necessary, that his decision would be final and binding on New Jersey to construct these additional works. Fifth, that much time might be lost after such notice before such work could be constructed. Sixth, that not knowing what these works are, and there being no intimation in the contract as to their nature, there is no evidence or security that these additional lawful works would remove any objectionable conditions found to exist.

Q. Mr. Horton, in your opinion, is it necessary or desirable or economical to dispose of sewage in accordance with the plans of the Passaic Valley Trunk Sewer project as provided in this stipulation.

Mr. Riker: The question is objected to as being entirely immaterial as to what this witness' opinion is on that subject.

The Commissioner: Note the objection of Counsel for Defendants.

A. In my opinion the project such as is proposed is not necessary, nor is it a desirable or economical way to dispose of the Passaic Valley Sewage. It is not necessary since there are other and more efficient methods, perfectly feasible and possibly less expensive, first, such as screenings and more efficient settling with disinfection; second, screening and settling followed by filtration or purification in coarse grained filters, such as contact beds or sprinkling filters. Furthermore these more effective works could be installed on the Newark Meadows or elsewhere, with a discharge either into New York Harbor or into Newark Bay. Furthermore, there might be individual or small groups of joint disposal plants for the different communities of the Passaic Valley District of a type such as above referred to, situated at different points within the Passaic Valley District, with discharges into the Passaic River or its tributaries.

3354 Q. After the studies which you have pursued during the period that you have given, and from the access that you have had to the various data and exhibits accumulated in this case, what in your opinion, Mr. Horton, would be the result of the discharge of the quantity of sewage through the Passaic Valley Trunk Sewer outfall at a point in the Upper Bay approximately at Robbins Reef.

Mr. Riker: The question is objected to on the ground that it is a hypothetical question, the basis of which does not appear to be proved in this case.

The Commissioner: Note the objection of Counsel for Defendants.

A. It is my opinion that there would be a nuisance created, and that there would be a menace to health created, the nuisance being more intense in the immediate vicinity of the outfall, but extending a considerable distance beyond it and carried to quite distant shores, a nuisance caused by discoloration of the water, offensive odors, deposits, diminution of the dissolved oxygen in the water and then there will be a menace to health from infection received from people using the bathing beaches and from infected material such as drift-wood, from the eating of shell fish, and there would be an indirect menace to health from the reduction of the vital resistance resulting from offensive odors, and objectionable conditions from the sewage as it will appear.

Mr. O'Sullivan: Your witness.

Cross-examination by Mr. Riker:

Q. Mr. Horton, when did you sever your connection with Messrs. Hering & Fuller?

A. In 1906.

Q. Why did you sever it?

A. To accept the position as Chief Engineer of the State Department of Health.

Q. Do you recognize your former employers as men of any standing in your profession?

A. I do.

3355 Q. Do you know that they have approved of this stipulation?

A. I did not.

Q. If they have approved of it, you are still of your own opinion that you have expressed here that it is faulty in every respect?

A. I am still of the opinion that I have expressed; yes, sir.

Q. Now, Mr. Horton, if all the sewage of the City of New York, including all of the Boroughs, were treated so as to produce an effluent corresponding with that which is described or guaranteed in the stipulation in question, what effect do you think would be produced in the harbor of New York?

A. I have just testified that what is stipulated cannot be accomplished. If you mean assuming that to be correct?

Q. That is what I said?

A. I wanted to be perfectly sure before answering.

Q. That is what I said.

(Question repeated by the stenographer.)

A. I think the Public health—I have already testified in regard to that partially.

Q. I want you to answer the question if you can. If you cannot you can say so.

Mr. O'Sullivan: Do you understand the question?

The Witness: Not thoroughly.

(Question repeated by the stenographer.)

A. My opinion is that if the sewage of these Boroughs in the City of New York were treated in such a way as to produce an effluent such as would meet the stipulations guaranteed, that the City of New York—will you repeat the question again?

(Question repeated by the stenographer.)

A. (Continuing:) A. I think the sewage would be sufficiently treated to prevent largely a nuisance, and would be substantially free from a menace to health.

3356 Q. And you think the same results produced in the proposed discharge from the Passaic Valley Sewer will create a nuisance in the harbor, do you?

A. No, sir. I will have to go back to that question relative to the specified sewage treatment and the guaranteed results. I have just pointed out that the sewage works will not accomplish the guaranteed results.

Q. I do not care about that. I want you now to keep your mind fixed on the guaranteed results. You have said now that if an effluent from the New York sewage was produced so as to result in the guaranteed results, there would be no nuisance. Why do you have to refer to those?

A. Because I have already answered that one.

Q. You must confine yourself to your written notes in order to answer on cross examination?

Mr. O'Sullivan: I object to the question as being clearly indefinite, the word "results" being so comprehensive as to include both the results which would come from the plant itself and the guaranteed results which could never be accomplished.

The Commissioner: Note the objection of Counsel for Complainants.

Q. Can you answer the question? If you cannot answer it, say so?

A. I cannot answer that question.

Mr. Riker: Very well, put it on the record, he cannot answer it.

Q. Can an effluent in your judgment be produced from the sewage of the Passaic Valley which will, when discharged in New York Harbor produce the guaranteed results as they are stated in the stipulation?

A. May I refer to the stipulation?

Q. Yes.

A. Yes, sir.

Q. And these alternative methods that you have testified to, toward the end of your direct examination, will any or all of them produce an effluent of the character that is guaranteed?

3357 A. Some of them.

Q. It is your opinion that the specific processes which are defined in the stipulation will not produce the effluent guaranteed?

A. Substantially I so say.

Q. Now, if you add some of the processes which you have testified to, as an alternative, will the guaranteed effluent be produced, in your opinion?

A. Substantially.

Q. Have you anything in your mind which indicates to your mind that these processes are unlawful?

A. It is a legal matter that I have not touched upon.

Q. Now, Mr. Horton, assuming that the instrument which has been spoken of as the stipulation is not signed by the State of New York and is not made with the State of New York at all, but simply expresses the intent of the State of New Jersey and the Passaic Valley Sewerage Commissioners, if that intent is carried out in the effluent guaranteed, will there be a nuisance produced in the Harbor of New York?

A. I do not know what the intent is.

Q. You do not know what the intent is—you cannot take the intent from the stipulation?

Mr. O'Sullivan: I object to the question. That is getting into the region of metaphysics.

The Commissioner: Note the objection of Counsel for Complainants.

Mr. Riker: We have had all sorts of stuff, metaphysics, and law and all sorts of stuff, and now I am getting a little metaphysics from this witness.

Mr. O'Sullivan: I also object to that part of Counsel's statement that this witness has dealt with any legal proposition.

The Commissioner: Note the objection of Counsel for the Complainants.

3358 Mr. O'Sullivan: I also object to the question on the ground that it is ambiguous, metaphysical and so extremely hypothetical as to take us into the regions of metaphysics.

The Commissioner: Note the objection of Counsel for Complainants.

A. Assuming that the intent of the Passaic Valley Sewerage Commissioners and the Secretary of War or the Government, in this case, is to carry out the guaranteed results, I think there will be very little nuisance and very little menace to health. I specified and explained that more in detail in my former reply.

Q. Well, now, Mr. Horton, are you familiar at all with the character of the property of the United States Government in the Harbor of New York?

A. Except as I see it passing by. I am not familiar with it all.

Q. Some of it?

A. You mean the Government property, the army fort there and the lighthouses? I have seen them, yes, sir.

Q. You are testifying as to that part of the stipulation which deals with the Government property, don't you know what it is?

A. Governor's Island and the fort.

Q. What else?

A. Robbins Reef Light, those are the principal ones I had in mind.

Q. You know the Brooklyn Navy Yard?

A. Yes.

Q. Do you know Ellis Island?

A. Yes.

Q. And if there is no injury produced on the property of the Government in the harbor by this discharge, what property do you think will be injured by it?

A. I stated because you may have a lot of property that is not owned by the Government and New Jersey and the part that is owned by the State of New York might be largely damaged from various sources.

Q. What kind of property would be damaged in your judgment if the property of the United States is not damaged?

3359 A. Why the shipping industry and the beaches and wharves.

Q. What else, anything else?

A. Those are the principal ones I can think of.

Q. You spoke of the boats?

A. I said shipping. I mean all the merchant marine, vessels.

Q. You mean the vessels themselves?

A. The vessels themselves, yes, also from the water used on the vessels that may be taken from the waters.

Q. Are there any United States war vessels in the harbor at any time?

A. I guess there are, for a short time.

Q. Are there any at the Brooklyn Navy Yard?

A. I think so.

Q. You have seen them there?

A. Yes, sir.

Q. Well, would they be injured if the other vessels which you have in mind were injured?

A. Injured from what; they are injured already probably.

Q. From the sewage?

A. From the sewage discharged from the Passaic Valley?

• Q. Yes.

A. Indirectly, yes, sir.

Q. If the stipulation is complied with and there is no injury to property of the United States, will there be any injury in your judgment to other like property in the Harbor?

A. Not if the stipulation—that part of the stipulation. We are coming back to that same question.

Q. The stipulation provides that there shall be no injury to the property of the United States in the harbor of New York, that is in general terms, from the sewage discharged from the Passaic Valley Sewer. Now, I am asking you if the property of the United States, ships and war vessels of different sorts, if they are not injured, whether other shipping of like character will be injured?

A. They might be because they are different types of vessels, a good many of them.

Q. In what in your judgment might the injury to these
3360 other vessels consist, which would not apply to the United States vessels?

A. I cannot think of any just now. I say there might be. I think I could think up some.

Q. Are there any wharves or piers belonging to the United States in the harbor of New York that you know of?

A. Wharves and piers?

Q. Wharves or piers?

A. I do not know what you refer to by those particular ones, no, sir.

Q. Are there any wharves on Ellis Island?

A. You referred to the Navy Yard. Assuming there are wharves around this place.

Q. I am not assuming anything. I am asking you whether there are any wharves or piers?

A. Yes.

Q. So that they would be injured from this discharge in your judgment?

A. Yes.

Q. Well, now, assuming that the stipulation is carried out and the property of the United States is not injured, and that the wharves and piers of the United States Government in the harbor are not injured, what injury in your opinion is going to occur to other wharves and piers in the harbor from this sewage?

A. These piers I have just testified to, those piers and vessels will be injured by the sewage from the Passaic Valley sewer, if you are now asking me a hypothetical question——

Q. I am asking you to assume that one of the stipulations as to the guaranteed results is actually carried into effect?

A. There will be no damage. There are two or three stipulations referring to the Government.

Q. There is only one regarding the property of the United States?

A. The sixth. I do not know what the United States will consider is injurious to them.

3361 Q. Will you read the stipulation and see whether it says the United States shall consider itself. I think it says there shall be no injury.

A. It says "injurious effect".

Q. Well, injurious effect then. You think that is different from injury?

A. There might be confusion.

Q. So you distinguish between injury and injurious effect?

A. I will accept this, that they are substantially the same. We will assume that they are the same.

Q. I want to know what your opinion is as to what classes of property will be injured by the discharge of the Passaic Valley sewage as proposed, in case the stipulation is carried out and no injurious results occur to the property of the United States in the harbor?

A. Well, the bathing beaches will be affected, that is one of them. The oyster industry will be affected. There may be a number of

other things that are not owned by the United States Government that are owned by the State of New York.

Q. They in your opinion may be sufficiently different from the property of the United States in the harbor so that injury might result to that property when it would not result to the property of the United States?

A. Very materially with respect to those two things just mentioned.

Q. Is there anything else that you can think of?

A. I take this as not a sanitary question, this injurious effect. It refers more to the injury to property, property injury. Of course, if it means any injury of any kind, we have got to go through this thing with a fine tooth comb.

Q. You have undertaken to interpret it?

A. I give you my opinion and my interpretation of how I accept this thing.

Q. You mean there would be injury to property, don't you?

A. I mean large injury to property, yes.

Q. Property situated in New York Harbor?

A. Property situated in the vicinity of New York, yes, take the bathing pavilions around here.

3362 Q. And the shell fish, anything else?

A. The bathing features.

Q. Anything else?

A. You are after a differentiation between the Government and the State?

Q. I want to know from what other things there would be injury that you can refer to?

A. Those are the ones that I think of just now.

Q. Now what will be the injury to the shell fish?

A. The shell fish will be injured by infection, by infected material that will be carried to them by the tides and winds.

Q. And they will become unfit to eat; is that the trouble with them?

A. Ultimately, yes.

Q. If they are not unfit to eat, what injury will be done to them in your opinion?

A. It may affect the industry. They may be unfit to eat, but people may eat them. From a hygienic standpoint, it may injure them by settling suspended matters on them and it may make them objectionable in appearance and thus destroy the industrial value.

Q. Would that constitute in your opinion a private nuisance or not?

A. That would be quasi private or public.

Q. Will you assume in addition to stipulation No. 6, Stipulation No. 5 in connection with it, and assume it is carried into effect that there will be no injury to public health occasioned by the discharge of said sewer into the harbor in the manner proposed, and no public or private nuisance created thereby. Now, assuming those two things are carried out, what injurious result do you anticipate?

A. I do not anticipate any substantial injury.

Q. And I think you have said, but I will take the liberty of ask-

ing it over again, that there might be, could be a treatment of the sewage of the Passaic Valley, which would result in an effluent which would make the results which are guaranteed?

A. Substantially so, yes, sir.

3363 Mr. Riker: I think that is all.

Redirect examination by Mr. O'Sullivan:

Q. Do you regard bathing beaches as property, and the paraphernalia that goes with bathing?

A. I have considered that as property, because I understand that I am taking it in a broad sense. A bathing beach is property. There is something there that is of value to the people or the state.

Q. Do you regard shell fish beds as property?

A. Yes, sir, in that general sense.

Q. Do you regard the paint on ships and boats as property.

A. I do.

Q. Now, if there is no injury to property, will there be any injury suffered by the property?

Mr. Riker: That is the logical and necessary conclusion, that if the stipulation is complied with, there will be none.

Q. Is it feasible for the plant described in the stipulation to produce the results guaranteed?

A. No, impossible I think.

Q. Is it feasible to produce these results short of prohibitive expense for such a large volume of sewage?

A. Using prohibitory in a broad sense, it would be impossible to. I would have to know what you mean by prohibitory. You mean very large expense?

Q. I mean if the expense would be so great as to be a very serious and unlikely burden to be assumed by communities?

A. Yes. It would cost considerable more than the present proposed method of treatment.

Recross-examination by Mr. Riker:

Q. Now, Mr. Horton, do you think that an effluent of less purity could safely be discharged into Newark Bay?

A. Safely, in regard to what?

Q. Safely as regards the inhabitants about Newark Bay?

A. Why, no, I do not think so. That is you mean the
3364 plant as proposed here?

Q. No, I do not?

A. You mean less than that plant?

Q. Should anything less than the effluent as guaranteed from a sanitary standpoint of view be discharged?

A. I do not think any less than that could be discharged into Newark Bay.

Q. Or the Passaic River?

A. Certainly not less.

Q. Or the tributaries of the Passaic River?

A. No,—they have gone down pretty near to the limit.

Q. Do you think the dividing up of this sewage and the establishment of separate disposal plants would be more economical than one disposal plant on the meadows?

A. I could not answer for that.

Q. Why can't you, that is in your line?

A. That depends on so many local conditions. It is absolutely impossible to answer that. I have that question put to me a dozen times a week almost and I simply cannot answer it without definite local information and some local calculations.

Q. You have some definite information?

A. I never estimated the individual plants along the Passaic River.

Q. You know the conditions along the Passaic River?

A. Yes, sir.

Q. You have studied them for some number of years?

A. Not the individual ones. Now we are talking about disposal. That is a very specific study.

Q. I want to know if you can express an opinion on it. If you can't of course do not do so, as to the relative economy of establishing separate disposal plants for all the municipalities in the Passaic Valley or taking the sewage to the Newark Meadows and disposing of it at one plant?

A. Assuming the same degree of purification it is impossible to tell whether individual plants would be cheaper than a joint plant or not, because it would depend on so many factors, such as the distances of these various outlets from the respective individual municipalities, the topography, the character of the soil, the type of plant, in order to produce the same effluent.

Q. You think, if there is any question, speaking generally, it is more economical to operate a large plant than a number of small ones?

A. It frequently is so, but not with a sewage disposal through a very long trunk sewer with a long expensive outlet.

Q. Assuming not a long outlet from the disposal works at all, but a comparatively short one. Do you think that one general plant is likely to be more economical or less so than a number of individual ones?

A. That is quite difficult to state owing to the fact that the short plant may be under very difficult methods of construction. If it is under water, or there may be conditions that may make it very difficult and expensive.

Q. You are familiar with the conditions around Newark. Do you know of any place where such a plant that you have in a general way described, could be located except on the Newark meadows?

A. I think there might be groups of them. It could be disposed of in other places.

Q. Take the City of Newark by itself as separate,—do you know of any place where there could be a disposal plant established except on the Newark Meadows?

A. I should not think of placing it any other place. That is the disposal plant such as I referred to, something beyond mere sedimentation, something like filter beds, contact beds.

Q. You know the conditions of the Passaic River about Newark?

A. Yes.

Q. In your opinion are they or are they not intolerable?

A. Yes.

Q. And the sewage, the disposal of it, in your opinion, should be taken out of the river?

A. Yes.

Q. Do you know how it could be treated or where it could be treated by a disposal plant other than in the general location of the disposal plant as proposed by the Passaic Valley Sewerage Commissioners?

A. It could be carried south or could be pumped almost anywhere.

Q. Do you think that it would be desirable to do that?

A. The City of Newark may value those meadows a great deal more than I would the pipe line extending from ten miles away. Of course, that may be water front, you know.

Q. Do you think your suggestion of separate systems of disposal would be prohibitive in expense to establish in the Passaic Valley Sewerage District?

A. I do not think so.

Q. But you think the general system is practically prohibitive, do you?

A. Now you are talking about something different than I had in mind. Are we comparing these as having the same effluent, or comparing one a purified effluent, such as I think ought to be put in there?

Q. I ask you whether an effluent less pure than that guaranteed in the stipulation—

A. I put a limit on it. I said at least that. If you want to get a higher purification, a drinking water standard,—

Q. You were asked as to the prohibitive character and cost of the production of an effluent such as is guaranteed in the stipulation?

A. Yes.

Q. And you said in your judgment that it would be so burdensome to the municipalities that it would be practically prohibitive?

A. No, I did not say that. I said it would cost a good deal more than the plant proposed, the scheme of disposal. That is what I said.

Q. But do not you remember, you were asked whether or not in your opinion it would be prohibitive?

A. Then I asked what you meant by prohibitive, and I got the understanding that we changed our answers a little from the former ones.

3367 Q. What would be in your judgment the financial aspect of the adoption of the necessary plant and works to produce the guaranteed results?

A. I think it would cost considerably more than the proposed plant. How much more I could not tell you and I gave a reason for that.

Q. Don't you remember you were asked whether in your opinion it would be practically prohibitive?

A. I remember your asking the question in regard to prohibitory.

Q. Do you think it would be extremely burdensome on the municipality?

A. To have individual plants?

Q. No, to have one plant which would produce the guaranteed effluent?

— According to the value that I put on sanitation, I do not think that it would be prohibitive, absolutely prohibitive, using the term strictly.

Q. Do you think that it would be very burdensome?

A. Think that it would be burdensome. It is always burdensome for municipalities to dispose of sewage. It costs money.

Q. And do you think that it would be burdensome for the individual municipalities to establish separate plants and operate them?

A. I think it would be somewhat burdensome, financially burdensome at least to some of them.

Q. Would it be in your opinion more or less financially burdensome than to join in the general purification plant?

A. That I cannot tell you because I do not know the relative cost of the two. You would have to have pretty good purification, and the different plants would vary in their types and the local conditions would vary considerably, and I have never seen any estimate of cost of the individual disposal plants, and I would find it a very difficult matter to give a snap shot judgment in regard to it.

Q. I think you will agree, will you not, that it is necessary to purify the Passaic River from sewage at the present time?

3368 A. No question about that.

Q. And I think you will agree, will you not that that purification must be accomplished either by diverting the sewage and discharging it beyond the limits of the Passaic River or by purifying it so that the effluent is no longer injurious to the river or bay water?

A. Yes.

Q. And if the latter scheme is adopted, I think you will agree, will you not, that whether it is by individual plants or by a general plant, it will be burdensome to the municipality from a financial point of view?

A. You are not asking for any comparison. I think absolutely it would be burdensome in the way I speak of that it would cost considerable money.

Q. And I think that you have said that you were not prepared to give an expression of opinion as to the relative burden?

A. No.

Q. You were asked in regard to bathing beaches being property and I want to know whether in your opinion that property value of bathing beaches will not be injured, if injured at all, from sewage, through the effect on the health of those that use them?

A. No, it might be damaged in another way, it might be damaged from the sediment getting down there. The suspended matters may drift over with the current.

Q. If there were no suspended matters?

A. I have said that there would be suspended matters.

Q. The difficulty with you, Mr. Horton, is that you are prepared to state that in your opinion "there ain't going to be no core"?

A. You have already specified the plant that you propose to put there. I do not understand that there is to be any other.

2309 Q. In your testimony you are assuming that no other processes or devices will be introduced into the purification of this sewage?

A. I do not say that. I do not think that I said that.

Q. Are you assuming it?

A. That they would not in the future?

Q. Yes.

A. Why, the contracts specify that there would be lawful additional improvements in the future.

Q. In the future?

A. If necessary and I pointed out the difficulty of showing when it was necessary.

Q. Why do you make it in the future?

A. It is proposed to put in a certain plant, and if that does not accomplish certain results then they will do something else.

Q. You ought not to testify to the contents of a written instrument without having it before you. Where do you find that, if they will not do it?

A. Substantially I will put it that way.

Q. Just point out what you refer to. I think it is the last clause of the second general paragraph?

A. I said substantially because my reason for it is you cannot tell anything about that until you get the plant constructed. They have got to construct it first before any lawful additional work would be installed, wouldn't they?

Q. Well, Mr. Horton, you recognize the fact that the agreement is in the disjunctive, don't you, that either through compliance with the requirements of the immediately preceding paragraphs or through requisite lawful additional arrangements?

A. Yes, I see that.

Q. That is the assumption that you are basing your testimony on?

3370 A. My assumption is they are to put in in the works, and the meaning of that clause is that if the works do not accomplish the results they will make it so by additional lawful works.

Redirect examination by Mr. O'Sullivan:

Q. Mr. Horton, I hand you Complainants' Exhibit No. 135 and call your attention to the paragraph marked Second on page 3, and ask if you as an engineer had to construct the plant described

there, whether you would follow the general description of the plant given in the section preceding that paragraph?

A. I would not devise a plant such as is described.

Q. Why not?

A. Because I do not think it would accomplish those results.

Q. Under that stipulation you would be expected first to try that plant, to see if it would yield those results, as an engineer?

Mr. Riker: The question is objected to on the ground that it does not appear by whom he would be expected to do it, and it is immaterial anyway.

The Commissioner: Note the objection of Counsel for Defendants.

A. I do not understand the question, Doctor.

Q. If you were called in as an engineer to design the plant as described there, I ask if you would first design that plant in accord with the terms of the stipulation and see whether or not it yielded the effluent that was guaranteed before you would add any additional plant, or additional means of securing that effluent?

A. Well, if I had a free rein to do what I knew was proper in designing the plant I should design a plant more efficient than that described here.

Q. If you had to follow that stipulation and take it as
3371 your guide, whether you would feel bound to first erect a plant such as is described there, before you would think of arguing the process of that plant?

A. It is pretty hard for me to say what I would do. That is rather a hard question, as to whether you would design a plant which you thought might possibly in a pinch perform the results. Now, I do not think that I would design a plant such as is described there, but as to whether I would put in something that I thought would be less efficient and try it out before I tried something else—I do not think that I should do that.

Q. Mr. Horton, I now direct your attention to what I now propose to read from Complainants' Exhibit No. 135, page 3, the paragraph marked Second. "The Passaic Valley Sewerage Commissioners further agree with the United States that in the operation of said sewer system at all times the following results shall be secured, either through compliance with the requirements of the immediately preceding paragraphs or through requisite lawful additional arrangements." I now ask you as an engineer whether it would be proper to erect that plant and see if it yielded these guaranteed conditions of the effluent, before applying any additional arrangements to secure it?

A. I understand the situation a little better, and I would because it specifically states in that paragraph,—given this as a basis for my work and my design, I would feel in duty bound to do that.

Q. Mr. Riker asked you some questions relative to the burdensome features of separate disposal systems and this trunk sewer project. I ask you if there are not to your knowledge communities along the Passaic River that have made computations along these

lines and determined for themselves that it would be less burdensome to put in a separate sewage disposal system than to join
3372 as a party to the trunk sewer project?

A. I know of one case, yes, it is of my general knowledge that there are a number of cases of that kind, more particularly, I think Paterson.

Q. Montclair, or the Oranges?

A. I have no direct knowledge. I have been advised by people who I think know, that Montclair has developed a scheme for sewage disposal in an individual plant located somewhere in the vicinity of Glen Ridge.

Q. And was that separate disposal system to be installed on the basis of efficiency and economy as against the Passaic Valley Trunk sewer project?

A. I do not know about that.

Recross-examination by Mr. Riker:

Q. Mr. Horton, don't you know that Paterson has entered into the Passaic Valley agreement?

A. It may have lately, I do not know.

Q. You do not know whether it has or not?

A. I am not positive, no, sir, and I refer to Paterson more with reference to the study made by Hazen with the conclusion that Paterson could more economically dispose of sewage on the Hackensack meadows that it could in the Passaic Valley District.

Q. And is that all your understanding as to Mr. Hazen's report on Paterson?

A. That was one of the options. That was one of the optional schemes shown, to carry it over there.

Q. You do not know whether he recommended that Paterson join in the Passaic Valley project?

A. I do not know whether Hazen recommended that. I do not remember.

Mr. O'Sullivan: I have got the report in which he said that if any purification scheme were adopted, it would be more economical to go into a separate disposal system.

Q. You have been asked what you would do as an engineer under certain conditions. Now, as an engineer if you were required to construct a plant so that when operated it would
3373 be operated in accordance with certain requirements, which are the requirements A and B and C of the stipulations, a copy of which report you have before you, I suppose that you could build a plant which would be operated in accordance with those stipulations?

A. If that were all.

Q. Whether it is all, or whether it is not all. If your order was to construct a plant which should be operated in accordance with A, B and C would you build such a plant?

A. I could not, for the reason that some of those are indefinite,

it is not specific as to what it is. In fact I have assumed in some of my calculations, I have had to assume dimensions here, but generally speaking, if I were ordered to build a plant and it were definitely stated and I accepted the order, I would go ahead and build it.

Q. And if in addition to that you were ordered to produce a plant which should include the features in A, B and C, which plant would discharge an effluent of the character indicated by paragraphs 1, 2, 3, 4, 5, 6, and 7 in parenthesis under the second section, then you would do that?

A. I would be up against it. I would be pretty hard up against it.

Q. Why?

A. Because I would say it was impracticable to do it.

Q. Could you not add to A, B, and C, features that would produce the 1, 2, 3, 4, 5, 6, 7?

A. Then I would not be constructing under A, B and C.

Q. Would you necessarily have to omit some of the things specified in A, B and C?

A. I would have to add considerably more, and perhaps modify at the outset.

Q. You could by adding to A, B and C, you could produce 1, 2, 3, 4, 5, 6, 7?

3374 A. No, not necessarily, because A, B and C involve structures, outlets in place, and if I were taking it up de novo I might not adopt that same kind of a scheme at all.

Q. That is a question of efficiency and economy?

A. Somewhat, possibly.

Q. Is it not possible to add features to A, B and C?

A. Generally I think you could have screening and sedimentation and add additional works and produce an effluent which would produce the results guaranteed under 1, 2, 3, 4, 5, 6.

Q. Now, if you were directed and accepted the job of putting in a plant which would embrace A, B and C and would produce 1, 2, 3, 4, 5, 6, 7, would you or would you not put in the additional features necessary, as an engineer?

A. No, I do not think that I should on account of the section under Second, under compliance. I would feel that that meant that you would be expected to try something whether you knew it was right or not and see whether it worked.

Q. I am assuming that you are directed to build a plant which would involve A, B and C under the first general section and would produce the results 1, 2, 3, 4, 5, 6, 7, under the second general section. I am now asking whether you would or would not add the additional features to A, B and C, necessary to produce 1, 2, 3, 4, 5, 6, 7, under the second general section?

A. I presumably would not until after I had constructed A, B and C.

Q. You would not do it, believing from your professional experience that A, B and C would not produce the guaranteed re-

sults, your mean to say that you would not add the additional features, if you were directed to produce the guaranteed results?

A. If I were directed under those conditions I would be directed to do so regardless of my opinion whether they would or would not. You cannot get away from that ethical question involved there.

3375 Q. It is purely a question of professional opinion whether or not A, B and C will produce 1, 2, 3, 4, 5, 6, 7?

A. I say they will not.

Q. Then if you were required to produce 1, 2, 3, 4, 5, 6, 7, you would have to add additional features?

A. If I was going to accomplish that and undertook the construction of the work to accomplish that, I would have done that in the beginning. That is a little different than if I were given a free rein. When it says they shall be accomplished either through compliance with the requirements of the immediately preceding paragraphs or by requisite lawful additions—that to my mind intimates that it was the opinion of the person giving me the orders that A, B and C would do the work. He simply asked me as a constructing engineer to come in and construct those works and presumably I would go ahead and do it if I accepted the job, regardless of sanitary consequences.

Q. Your trouble is that you do not agree with the proposition that A, B and C will produce the result?

A. I have stated that A, B and C will not produce 1, 2, 3, 4, 5, 6, 7.

Q. In your opinion?

A. Yes, sir.

Redirect examination by Mr. O'Sullivan:

Q. Mr. Horton, can the sewage of 37 municipalities and towns be treated more efficiently by the separate sewage disposal system or in concentrated form where it is collected and has become stale?

Mr. Riker: The question is objected to on the ground that the question is hypothetical and is not based on any facts proved in this case.

The Commissioner: Note the objection of Counsel for Defendants.

A. I think it is very difficult to say, to give a definite answer to that question. My opinion is generally that it is better to take the sewage and treat it when it is more fresh than when it
3376 is in a stale and septic condition and it is frequently more economical to treat it individually than it is the other way, although with a very long trunk sewer the opposite may obtain.

Mr. O'Sullivan: That is all.

Mr. Riker: That is all.

Mr. O'Sullivan: Complainants rest.

Adjourned subject to the call of the Commissioner.

3377 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
vs.
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COM-
MISSIONERS, Defendants.

Testimony on Behalf of Defendants.

Taking of testimony at the office of Messrs. Riker & Riker, New-
ark, N. J., Friday, December 27th, 1912.

Before James D. Maher, Esquire, Commissioner.

Appearances:

Thomas Carmody, Esquire, Attorney General of the State of New
York; William A. McQuaid, Esq., Deputy Attorney General; Dr.
William J. O'Sullivan, Special Counsel, for the People of the State
of New York Complainants.

Edmund Wilson, Esq., Attorney General of the State of New Jer-
sey; Robert H. McCarter, Esq., of Counsel for the State of New
Jersey; Adrian Riker, Esq., of Counsel for the Passaic Valley Sewer-
age Commissioners, Defendants.

Doctor O'Sullivan: Mr. Commissioner, before the defendants in-
troduce testimony I want to have two substitute exhibits put in;
when I put in exhibit #157 I had only the advance sheets and I
should like to offer the perfected copy itself in evidence, I have that
perfected copy here properly certified and I ask that it be marked
Complainants' Exhibit #157 in place of the temporary copy
3378 already offered.

Mr. Riker: Subject to the same objection made to the offer
of the advance sheets.

The Commissioner: Yes, the objection of defendants' counsel is
noted.

(The perfected copy produced by Dr. O'Sullivan was then marked
Complainants' Exhibit #157.)

Dr. O'Sullivan: I also offered in evidence what purported to be
the stipulation entered into between the United States Government
and the State of New York and the Bronx Valley Sewerage Commis-
sion, which was marked Complainants' Exhibit #177; at the time
that exhibit was offered I stated that I had applied to the office of the
Clerk of the Supreme Court of the United States for a copy of the
original stipulation and after the paper I offered had been marked
as an exhibit I received such copy, which I now offer in evidence in
place of the other one. This is an authentication copy of the stipu-
lation which is now offered in substituted for for the temporary one
and I ask that it be marked Complainants' exhibit #177.

The Commissioner: Let it be marked.

(Marked Complainants' Exhibit #177.)

ASA HENRY PHILLIPS, a witness on behalf of the defendants, being duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. Riker:

Q. Where do you reside?

A. Washington, D. C.

Q. What is your profession?

A. Civil and Mechanical Engineer.

Q. Will you state your age?

A. Forty-six this year; just past forty-six.

Q. Where did you receive your training and education for your profession?

3379 A. I graduated at Lehigh University in the School of Civil Engineering in 1890.

Q. And with a degree?

A. Degree of Civil Engineer.

Q. After that, what was your training or education in your profession, or your experience in your profession?

A. Soon after I graduated, some few months after, I became connected with the Engineering Department of the District of Columbia, engaged on drainage work, and was Assistant Engineer on construction work until 1900 when I was appointed Engineer and placed in charge of the preparation of plans for, and the construction of, a sewage disposal system for the District of Columbia; I was engaged on that work until 1908, when I was appointed superintendent of the sewer department of the District of Columbia, having charge of the construction, operation and maintenance of a sewerage system and sewage disposal system.

Q. In connection with occupation and experience which you have detailed did you do any outside work in the line of preparation for your career?

A. Yes. Directly in connection with our work at Washington I made a number of visits to, and studies of drainage work in Eastern Cities and along the seashore in connection with a detailed study of plans for the disposal system.

Q. What cities did you visit in that connection?

A. I visited Boston, New York, Philadelphia, Baltimore and also some of the Lake cities, Buffalo, Cleveland, Chicago.

Q. Did you visit Providence?

A. Yes, Providence, Rhode Island.

Q. In your visits what special work did you do?

A. It was an inspection of the drainage system, particularly as to the condition of discharge outlets and outfalls with a view of ascertaining as far as could be the condition of the streams and
3380 harbors into which the sewage was discharged, its general effect upon them and what might be done to better conditions as they existed elsewhere in our new work for Washington.

Q. Are you a member of any professional society?

A. I am a member of the American Society of Civil Engineers and the American Public Health Commission and several other more

or less local societies in Washington not connected directly with sanitary engineering.

Q. What is the population of the city of Washington?

A. The present population is about 350,000.

Q. And the area of the municipality?

A. The municipal area is about 70 square miles; 69.25 square miles, I think, to be exact.

Q. How long did you say you had been connected with the sewerage system of Washington?

A. I have been connected with the sewerage system of Washington for more than twenty-one years.

Q. What is the length of that system at the present time?

A. About 618 miles.

Q. Is it a separate or combined system of sewage?

A. It is a very generally combined system, with considerable mileage of separate system also.

Q. When you speak of "combined system" what do you mean by that exactly?

A. Drainage that provides for sanitary flow, house drainage, and for surface water, running water and sewage.

Q. How long has the present system been in actual operation in the city of Washington?

A. Five years.

Q. Prior to the time of five years ago, how was the sewage of Washington discharged with reference to the points of discharge?

3381 A. It was all discharged at the shore lines, wharf lines.

Q. Into what body of water?

A. Into the Potomac—into all the water front which is divided rather artificially by reclamation of the Potomac flats and into the Potomac River direct, the eastern branch of the Potomac and the Washington channel.

Q. Is there any discharge into the Anacostia River?

A. Yes; the eastern branch of the Potomac River is synonymous with the Anacostia River, it is just a different name.

Q. Will you describe the present disposal system of the city of Washington?

A. The present disposal system, by extensions and intercepting sewers along all the water fronts, collects the flow from the sewerage system itself and delivers it to the main sewerage pumping station, located within the city on the water front; there the sewage is passed first through sedimentation basins and then through screens, then through the sewage pumps, then through a skimming tank, from which it flows through submerged syphons, two six inch diameter pipes under the river to the opposite shore; then from there it is carried by gravity to the point of discharge down the Potomac River just above Alexandria; at the shore line it passes again into submerged pipes extending out to mid channel in the Potomac River in about thirty feet of water, with upturned elbows, and there the discharge takes place.

Q. How long is the outfall line, from the sedimentation basins, to the point of discharge?

A. It is between three and four miles, I do not recall the precise distance.

Q. How long is the sewage detained in the sedimentation basins, the skimming basins?

A. I would have to think of those figures for just a moment.

I should suppose the average would be between five and ten minutes, very close to that.

Q. Won't you tell us what the character of the water is at the point of discharge of the Washington sewers, with reference to its being tide or land water?

A. It is tide water.

Q. Can you state the mean rise and fall of the tide at the point of discharge?

A. About 2.92 feet; it is called, commonly, three feet, but that is the average tidal range.

Q. How far up the river above the point of discharge does the tide rise and fall?

A. About seven miles; between six and seven miles.

Q. Does that take it up above the city of Washington?

A. Oh, yes.

Q. What is the minimum dry season flow of the Potomac River?

A. The minimum flow has fallen below a thousand second feet, not very much below a thousand second feet.

Q. Can you translate that for us into gallons?

A. Yes, that would be about 650,000,000 gallons per day.

Q. Approximately, what is the distance of the point of discharge of the sewage from the ocean?

A. It is about 100 miles from Chesapeake Bay and the mouth of the bay—of the river—is about 100 miles from the ocean; about two hundred miles.

Q. What is the discharge from your sewers into the Potomac River?

A. In quantity?

Q. In quantity.

A. From sixty to seventy-five million gallons per day.

Q. How long has this system been operated?

A. Five years.

Q. Has that been a continuous or intermittent operation?

3383 A. There has been no stoppage; it has been continuous from the day it started.

Q. Where is the point of discharge located with reference to the city of Alexandria?

A. The discharge above the old city is perhaps a mile and a half, but the city is building northward until it is getting much nearer than that to the outfall.

Q. How wide is the river at the point of discharge?

A. The distance from shore to shore at high water mark is between three and four thousand feet; the channel width is about half of that, less than half of that; it is about fifteen hundred feet.

Q. Have you made any examination of the river shores since the operation of the system as it now is?

A. Yes, I make regular examinations of the banks of the river along the stretch both above and below the point of discharge and outfall, and opposite.

Q. And have you made any examinations of the Potomac River?

A. Yes, I have taken samples of the bottom of the river above and below the outfall, in that stretch of water.

Q. Has that been done intermittently or periodically or systematically, or how have you done it?

A. That is done at regular intervals.

Q. What have you found to be the condition of the river shores in the vicinity of the outfall since the operation of the present system?

A. We have never found the slightest indication of any result from the discharge of sewage at outfall, on the shores themselves, that is, no material can be ascribed to discharge from the outfall; the shores are clean and entirely free from any evidence whatever of the sewage discharged.

3384 Q. Have you made any comparison of the conditions now with what they were before the system was installed?

A. Yes. The conditions along the river, cityward, are very much better than they were. I was on river work for ten years at Washington and I have found since the sewage disposal system has been in operation, the river shores all along the vicinity of the city, along the Potomac River, the Washington channel and the Anacostia River, are materially improved and are really clean, where formerly they were rather objectionable in a good many places.

Q. What were the results, as found by you, of the examinations of the bottom of the river in the vicinity of the outfall?

A. Our last samples, taken after we had had five years of discharge, were like all the others we have taken. We have rather a sandy bottom and the samples show absolutely no sludge deposit whatever.

Q. With reference to the water of the river at the point of discharge does it vary from time to time in clearness, I mean the natural water?

A. That is the river water?

Q. Yes.

A. The river, of course, at times is rather turbid and at other times it is very clear; with high storm discharges the turbidity of course increases very much.

Q. Have you made observations or have you not of the water in the vicinity of the outfall of the different conditions as to turbidity and clarity?

A. I have.

Q. What has been your observation as to the appearance of the water at the point of outfall, of the different conditions of turbidity and clarity as you observed them, so far as the influence of the discharge of sewage is concerned?

3385 A. The water has been so unaffected by the discharge that in the great majority of times it has been very difficult indeed to locate the discharge at all even in a boat I mean, passing over

it and searching for particular points; with our upward elbow discharge of course it makes a slight—the weight of the water discharging would have a tendency to make a slight rounding of the surface but even with that, we find it very difficult to locate it in the majority of times. It is free from floating material, from visible suspended material; it is not affected in color and there is absolutely no odor so far as I have ever been able to determine, even from a boat directly over the point of discharge.

Q. Are there any sleek or grease fields or sewage fields over the points of discharge?

A. I have never observed any.

Q. Or any evidences of surface grease observable by you?

A. No.

Q. You have not seen any?

A. I have not seen any.

Q. Have there been any tests made under your direction or observation as to the dissolved oxygen contents of the water of the Potomac River?

A. Yes, we make regular tests, three times a week, of samples of water at the outfall, and, for comparison, of samples of water in the upper river; these samples are taken at the same time, or, as nearly as possible at the same time, the boat proceeding from one point to the other, in order to keep a check on the loss in oxygen due to the discharge of sewage in the river at the point of outfall.

Q. The basin at the outfall during the past year, can you state what the oxygen contents show?

A. They show a drop in oxygen, a maximum drop of 3386 about 12%—all our figures are on per cents—a minimum drop to zero and I think the average drop is about 4%. That is the difference between the oxygen determination in the upper river and the oxygen determination at the outfall. I would like to ask if I may have that question repeated.

Q. (Last question read.)

A. Perhaps I have not answered that. The minimum oxygen is a little under 60. The maximum 100, and the average about 80%.

Q. In the upper river, what did the determination of oxygen contents of the water show during the same period?

A. In the upper river samples for the past year we have a maximum of 100% saturation, a mean of about 92% and a minimum, I think, just under 70.

Q. Are there any fish in the Potomac River?

A. Yes, we have Potomac shad, herring, and in the lower river we have yellow and white fish, rock fish, cat fish.

Q. Where are these fishes caught?

A. At the present no seining is done within the district on account of local laws to protect the fish, but from the district line down the river, for a very long distance, there is seining for herring and shad during the Spring and trap net fishing for other fish during the Fall, and, within the district, in the portion of the river near the outfall, we have considerable fishing for white and yellow perch, principally that, and the other fish I have named and some of the

best fishing grounds we have for fish of that character are along that stretch of the river.

Q. Is this fishing conducted at distances from the outfall or near the outfall?

A. One of the favorite places is perhaps a half a mile above the outfall at the Steel Company's wharf; another favorite place is at the mouth of Four-Mile-Run, right opposite the outfall. I 3387 say opposite, I mean on the Virginia side of the River as opposed to the District side.

Q. Have you any explanation to offer of the favorable conditions which have been testified to by you from the outfall or discharge of the sewage at the point in the Potomac at which it is now made?

A. After having had about nearly fifteen years' experience with the old system, and a study of the old sewers along the water front, and contrasting that with our five years' experience with our present discharge, it is my judgment that the excellent results we have obtained have been accomplished by the method of intercepting the sewage, primarily, that is by sedimentation, screening and skimming and incidentally the discharge through the pumps which tends to break up the solids and assists in the general work, but principally the removal of these wastes, largely organic wastes, which caused us a great deal of trouble along the water front at the mouth of our sewers, formerly.

Q. Have you had any opportunity for special determination of evidence in support of this conclusion, in your system there?

A. We had a particularly good case of that sort in connection with the construction of the sewage disposal system. It was necessary, of course, to complete one large line after another and after the Tiber Creek and New Jersey Avenue high level interception was completed it was necessary to connect the flow from the same with the temporary pumping station and to discharge the sewage into the river at the bulkhead line for two or three years before the whole project was completed and the large station ready for operation. This discharge was in a portion of the river where there were no other sewers and the sewage was discharged without sedimentation or treatment of any kind. We found, after we had been in operation less than a year, that we had a great deal of difficulty 3388 in the condition of the river front and, what was more objectionable and more troublesome to us, sludge deposits and during the succeeding summer and the summers thereafter, particularly it was quite offensive. There was a continual bubbling, bringing the considerable masses of sludge from the bottom up, with odors, and of course there was a bad surface condition from the visible presence of the sewage on the surface. After we put the whole plant into operation of course this disappeared in a comparatively short time.

Q. From your observation in connection with the Washington system what is indicated, in your opinion, as to the difference in the effect of the discharge of crude sewage without sedimentation, screening or skimming, and that of sewerage subjected to these methods?

A. I think there is every possible difference, the freedom from

surface indications of the sewage, the clearness of the water unaffected in color or odor, the absence of visible floating material and, at our outfall the entire absence of sludge, contrasted with the old conditions and with the conditions of sewers directly discharging elsewhere, all of which indicate about the same effect in the immediate vicinity of the discharge, lead me to conclude that the benefit of the treatment of the sewage is not valued nearly as high as it ought to be.

Q. On the city water front of Washington has there been any change since the introduction of the present system in the condition of the pier heads, wharves and boat houses from that which existed before it was introduced?

A. I think, as I stated, the conditions are very materially improved. There is an absence along the piles of the wharves and along the sea walls of the ugly effect resulting from nearby sewer discharge, it is practically absent. By that I mean it has
3389 now almost entirely disappeared. Of course, immediately after our system went into service these results hung on for a long time, but they are in admirable condition to-day in that respect.

Q. Have you made any observations to determine whether or not these objectionable conditions have returned below the point of discharge from the present sewage system?

A. Absolutely not; that is, we have had no such results. We have, immediately opposite the discharge, a small wharf, the U. S. Naval Magazine has a wharf immediately below the discharge and, as I have stated, in the examination and study of the conditions in that stretch of the river, we have found absolutely no indications of conditions such as are apparent at the city water front under the old system and no indication whatever of any effect from the discharge of sewage at the outfall.

Q. I show you a paper marked "Complainants' Exhibit 135" and ask you whether you have seen and examined that exhibit?

A. I have.

Q. Are you familiar with New York Bay?

A. I have been on it and around it for more than twenty years, rather frequently.

Q. Have you made a visit to it recently?

A. Yes, I have been around on a number of water fronts down the Bay.

Q. How lately?

A. Within the past ten days.

Q. And for the purpose of testifying in this case?

A. Yes.

Q. Where did you go on this last visit to the Bay, what parts of the bay did you visit?

A. I went across the upper Bay, along the shore of Newark Bay and down as far as Staten Island, then along the East River on the New York side and then on the Brooklyn side along the
3390 East River.

Q. Did you observe the conditions of the water on that visit?

A. Yes, sir.

Q. What did you observe along the shores of the East River as to the condition of the water so far as sewage is concerned?

A. I observed large quantities of sewage and very visible evidences; large sewage fields and quantities of sewage along the slips and at the pier heads.

Q. How far out into the river did these appearances show?

A. Along the East River the day we observed them I should think they would extend half way across, or possibly less, not more than one-third; I would say about one third the way across the river.

Q. Beyond that point what was the condition of the water as you observed it?

A. So far as it could be seen the water appeared to be generally in very good condition.

Q. Do you know where the proposed point of outfall of the Passaic Valley Sewerage System is located?

A. Yes I do.

Q. Taking Complainants' Exhibit #135 and directing your attention to the first paragraph marked "First", how does that system of purification or partial purification of sewage compare with that which you have in operation in Washington?

A. In all respects, that is in the three respects, it is very much more exacting.

Q. Take in the first place the element of screening, in what way is it more exacting than the screening which is applied to the Washington screening?

A. We have only the coarse screens and this provides for very fine screens. I might say that we are going into the fine screening ourselves somewhat, but not as this is. This is very much finer than anything we have. I do not think there is any definition here of what the coarse screens should be but judging from parallel practice elsewhere and in Washington I should imagine ours would be about the same as what is specified as coarse screens.

Q. In addition to coarse screens you observe that there is also additional screening?

A. Yes, sir. I say in the matter of screening it is a very much more exacting requirement.

Q. Now take the element of sedimentation and state in what respect this stipulation is more exacting as to sedimentation than is applied to, and is the case in, your work at Washington?

A. This sedimentation is far more exacting. It provides for about twelve times as much—more than twelve times, between twelve and eighteen times as stiff a requirement for sedimentation as we have.

Q. Now the third element you refer to, what is that?

A. That is the removal of surface oil and grease. That is not set forth in the stipulation, that is, there is no quantitative method of determining that this is more exacting but from the size of the chambers from which this would be removed, the surface areas available for the removal, they ought to have easily the opportunity to, and

should, remove that much more effectively. Of course, after you get to 100% removal you cannot get any more out of it, but the opportunity for removal would be there just the same.

Q. With reference to the condition of the waters into which the effluent is to be discharged by the Passaic Valley Sewer, simply with reference to the quantity for dilution, how do the conditions in New York Harbor compare with those in the Potomac?

3392 A. As nearly as I have been able to determine from the published figures in the various reports of tidal flow in the New York Harbor their conditions are about such as our maximum condition of river flow, based on the amount of dilution, per capita, for our river flow drops down until we have as small as ten to one dilution, or even under that of actual quantity at times.

Q. Your statement with regard to per capita flow in New York Bay, is that extended to the population tributary to New York Bay or not?

A. The whole population; as I remember the figures they run up on the estimated populations just as we do to a period running up to I think 1940; that the effective dilution is upwards of 250 to one or more.

Q. The stipulation which you have before you, contained in exhibit 135, provides for a point of the discharge of the effluent and the depth at which it is to be discharged; how does that compare with your Washington discharge?

A. We discharge in a little under thirty feet of water, this is stipulated to be forty feet of water. Both are channel discharges. The Washington sewage is discharged through two vertical elbows sixteen inches in diameter, discharged upward with no attempt made for a large field of spread for dispersion. This stipulation required multiple outlets on several lines, four I believe, covering a very considerable area. That, of course, must have a very great deal of influence in the rapid dispersion of the sewage and prevents the formation—probably one of the most objectionable features of concentrated discharge—of masses of sewage.

Q. Which in your judgment is likely to be the more efficient?

A. Absolutely the multiple discharge.

3393 Q. As to the element of depth of discharge, is there or is there not any advantage in having it ten feet deeper than the Washington discharge?

A. That would assist materially in the dispersion; the greater the depth the more satisfactory is the dispersion.

Q. With the effluent produced by the process described and specified in complainant's exhibit #135 which you have had before you, and discharged as therein specified, in your opinion, based upon your experience at Washington and elsewhere, will there or will there not be an absence in New York Bay of visible suspended particles coming from the Passaic Valley Sewage?

A. In my judgment there will be an absence of visible suspended matter.

Q. Will there or will there not in your opinion be an absence in New York Bay and its vicinity of odors due to putrefaction of or-

ganic matters contained in the Passaic Valley sewage thus discharged?

A. In my judgment there will be an absence of odors.

Q. In your judgment will there or will there not be a practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley Sewage at the dispersion area or elsewhere?

A. In my judgment there will be an absence of grease and a substantial absence of color.

Q. In your judgment will there or will there not be a public or private nuisance created in New York Harbor by this discharge?

A. In my judgment there will be no public or private nuisance created by this discharge.

Q. In your judgment, based upon your observation as to fishing in the Potomac below your outfall, will there be a reduction
3394 in the dissolved oxygen contents of the waters of New York Bay resulting from the discharge of Passaic Valley sewage to such an extent as to interfere with major fish life?

A. In my judgment there will not be such a reduction in dissolved oxygen as to interfere with major fish life.

Q. Have you any knowledge of any sewage system discharging into any tidal water under as stringent conditions as to purification as are proposed for this discharge?

A. I presume the question refers to the discharge of large cities?

Q. Yes.

A. Not to any special or small—

Q. Yes, I am referring to city discharges.

A. I know of none.

Q. Are you familiar with the Boston system at all?

A. I am.

Q. How does that compare in stringency to the condition of the effluent with the conditions imposed in this stipulation?

A. The conditions are much less than ours at Washington and very much less stringent than those required under the stipulation.

Cross-examination by Dr. O'Sullivan:

Q. What is the character of the sewage at Washington as to whether it is residential or whether it is admixed with trade wastes?

A. The sewage of Washington is very largely residential.

Q. What trade wastes, if any, are added to the sewage?

A. As the term is ordinarily understood we have comparatively
3395 little. We have a few—one or two—pulp mills from which we get some discharge but our principal source of material of that sort is from the government operations, principally from the Bureau of Engraving and Printing; from that we get large quantities of plate printer's ink and with it a very great deal of color as well as heavy material.

Q. What are the constituents of trade printer's ink?

A. I cannot answer that.

Q. What are the organic matters in addition to trade printer's ink?

A. You mean in the sewage or in that particular discharge?

Q. We are discussing the trade wastes from the printing office, I understand.

A. No organic matters at all.

Q. So that the trade waste would largely consist of this ink you have described?

A. That is one class, as affecting color, as giving an objectionable sludge. Of course, we have quite a number of slaughter houses; the discharge there is not very large, but there are a number of them.

Q. Do you take care of the refuse from these slaughter houses in your sewage disposal system?

A. Oh, not all of it; we take care of such as is admitted to the sewer.

Q. What percentage is admitted to the sewage system?

A. That I could not answer. I know there is a very considerable amount of material that we endeavor to keep out of the sewers which gets into them; heavy material.

Q. Where is that discharged?

A. That passes through the sewerage system to the sewage disposal system.

Q. Do I understand you that you do take care of all the refuse of these slaughter houses?

A. No, sir.

Q. Then, I say, the part you do not take care of, where
3396 is that discharged?

A. That is removed by the people themselves. I cannot tell you exactly what treatment that undergoes. Of course, not all the discharge from any slaughter house enters the sewer. It would not be practical to carry it through the sewers in any sewage system anywhere, but a very large part of it does get in; the blood, some particles of the entrails and particles of putrefactive material, and that we get.

Q. What I am trying to get at is where is the refuse that you don't get, how is that discharged?

A. It is not discharged, it is probably removed, it may be burned; I don't know, the great mass of entrails and material of that sort that are solid and heavy could not be discharged into a sewage system or into a sewer; they have no local discharge, if I understand your meaning. What other sewers might they discharge in? There are none.

Q. What is the salinity of the water at the outfall in the Potomac?

A. About zero salt.

Q. Practically fresh water?

A. Yes, sir.

Q. Have you had any experience with work in bra-kish or salt water?

A. I spent a lot of time in Boston Harbor and their sewage outfalls are in salt water.

Q. What is the salinity of the water at the Deer Island outfall?

A. That is pretty close to ocean water.

Q. Do you know that of your own knowledge?

A. Exactly what it is? I do not.

Q. Do you know what the salinity of the water in New York Upper Bay is?

A. I do not from actual tests I have made myself, I know
3397 what it is from my reading of reports of the Sewerage Commission upon it; that is, I believe I do.

Q. What do you recall it to be?

A. I recall it as one-third fresh and two-thirds salt; that is my recollection of it. In the Upper Bay, I understood you to say?

Q. Yes.

A. One-third fresh and two-thirds salt is my recollection, in round proportion.

Q. Does it make any difference in your opinion as to whether sewage is discharged into fresh, bra-kish or salt water as to its ultimate digestion and assimilation?

A. It has been my opinion for a long time that salt water or bra-kish water, where it was a considerable part salt water has certain advantages over the fresh water; as a matter of fact it is a pro and con proposition, there is some advantage on one side and some on the other, but altogether I have rather been of the opinion for a long time that salt water was a more satisfactory dilutant than fresh water, though not in every respect.

Q. In what respect is it not?

A. Fresh water has a more high capacity for oxygen, fresh water has a lower specific gravity. That is about all the difference.

Q. What factors make for the disintegration of organic matters discharged into either fresh, bra-kish or salt waters?

A. I don't know whether I get your question exactly, disintegration?

Q. Disintegration.

A. Will you repeat the question?

Q. (Question read as follows: "What factors make for the disintegration of organic matters discharged into fresh, bra-kish or salt waters?")

3398 A. If, by disintegration you mean the breaking up of solid materials I would say current, wave action, winds, marine life and factors of that sort.

Q. What percentage of the Washington sewage is organic matter?

A. That I could not answer; it is so variable in itself and it is a pretty difficult question to answer in any quantitative way.

Q. Can you give me an approximation?

A. The best definition of it probably would be the quantity per capita, inasmuch as the organic matter is very closely a factor per capita rather than per gallon or per quantity of the sewage itself. Our quantity per capita is about between 150 and 200 gallons per day.

Q. That indicates a large amount of fresh water in that sewage, does it not?

A. Yes, we have a rather large proportion of water.

Q. What is the meter consumption of water per capita in the city of Washington?

A. The city is only in a comparatively small part metered; there are estimates made of the daily water consumption but they are not from actual meters.

Q. What is the estimated per capita consumption of water in Washington city?

A. I think the average is somewhere about 160 gallons.

Q. If the average water per capita consumption is estimated at 160 gallons and you who are in charge of the sewage disposal system estimate the sewage per capita at 160 gallons, that would leave very little organic matter in the sewage would it not?

A. Well that is getting it a little fine. You know the percentage of organic matter in sewage is not very large and is not such
3399 as to very appreciably increase the total volume in any city anywhere.

Q. What I am getting at is that the organic matter in the Washington sewage is a very slight proportion of the sewage?

A. Oh, no, I would not say that.

Q. And what do you estimate it at?

A. As I stated a while ago, when you asked for a definite measurement, it would be perhaps the per capita daily consumption, for instance, if our average daily consumption is 160 gallons per capita and in adjacent places it were 80 gallons per capita, that would measure very fairly the strength as we speak of it of the sewage; that is, our sewage would have one-half the strength of the sewage of the place where the water consumption was 80 gallons per capita.

Q. Using these terms, would you describe the sewage of Washington as weak sewage?

A. No, I would not.

Q. Would you describe it as strong sewage?

A. No, it occupies a fairly middle ground and about on the proportion of the per capita in consumption; the per capita consumption, that is, is not largely above the per capita consumption of a great many American cities, and even smaller than some, and comparing the sewage on the same basis with that of other cities, it is certainly not the strongest.

Q. How would you define strong sewage?

A. Very much as I have indicated; that is as good a basis of measurement of it as anything I know of, that is, the total amount of quantity as against per capita.

Q. So that in measuring sewage you take the per capita water consumption and estimate on that basis the sewage per capita output?

A. Yes.

Q. What is the rapidity of the Potomac current during ebb
3400 at the outfall of this system you have described?

A. It will vary very much with different discharges of the river, normally the ebb is from one to two or three miles per hour.

Q. And running up as high as what?

A. Why I suppose it would get up as high as four or five miles.

Q. Would that exercise any scouring action at the region of the outfall?

A. I suppose there would be some slight action; I would not

gather from the studies I made of the bottom there would be very much, because of the materials we have taken up from the bottom such as leaves, for example, that would not resist very much the scouring action and we frequently get those right at the outlet.

Q. What is the grade of your sewers at Washington toward the outfall?

A. Going to the outfall we have a grade of 1 foot in 3000.

Q. Do you get a pretty rapid discharge to the outfall?

A. We get a very fair discharge which will vary from perhaps two and a half to three feet per second, or slightly more than three, a shade more than three under the highest discharge.

Q. The sewage would be very fresh when it reached the outfall—would you describe it as fresh sewage?

A. Oh, yes, it is fresh sewage; our average sewage would be about four hours old, possibly a little more.

Q. And practically all domestic sewage?

A. Very largely domestic sewage, yes.

Q. Have you ever tested the sewage effluent to make oxygen determinations, before discharge in the Washington outfall?

A. We have had some tests of it but we have not maintained any regular work on it.

Q. But you have found a fair percentage of oxygen in the effluent?

A. No, I think the only tests we have had have shown practically none.

Q. No oxygen?

A. Or very little, there has been some but it has been very slight.

Q. I understood you to say that you had done regular oxygen work in the neighborhood of the outfall?

A. Yes.

Q. And the oxygen averages 89%?

A. No, it averages 89% for the past year; my recollection is the question was as to the past year, but that varies very much from year to year.

Q. What would be a fair average for the five years?

A. I would put the average for the five years as about 80; possibly slightly over 80; about 80 I should say.

Q. What was that minimum of 60%; when did you get that?

A. That was during the past year.

Q. What did you attribute going below the average for the five years of 20% to?

A. What did I attribute that to? That is due to a lot of complex conditions; it is due to the temperature variation, it is due to the condition of the water of the river above, not affected from our sewage discharge. There are times in the year when it has a good deal more work to do on organic matter, other than the sewage, which reduces its oxygen, so that it comes to us lower in oxygen. Then there is the variable flow of the river and in getting down towards minimum flow we have less water and less oxygen for the work of reducing the sewage.

Q. How far up the river do your determinations extend for oxygen contents?

3402 A. Our upper sample on the river water is taken very near the highway bridge across the river, that is, opposite the Potomac Park.

Q. Well within the city limits is it?

A. Oh, yes.

Q. I asked how far up the river, above the city limits, you have made oxygen determinations?

A. We have made none, the sewer department.

Q. On what then do you base the statement that the river water comes to you lowered in oxygen at certain times?

A. From the results we get from the samples taken above the city, that is, above the effect of sewage discharge, where there is no sewage discharge; that is, above the Washington Channel a mile or more. The only portion of water front where there is sewage discharged is below this point where we take our samples and we consider that a sample of river water taken there is a fair way to determine the condition of the water above the point where it is affected by the discharge at outfall.

Q. If I understand you right you do not make any determination above the point of discharge of your sewage, is that correct?

A. Oh, yes, we do, this point I am speaking of is way above the point of discharge, several miles above it.

Q. And well within the city limits?

A. Oh, yes. Well, the city limits—we have no city limit really, the District of Columbia extends miles up the river. You see we have about seventy square miles of country and that covers nearly ten miles of water front.

Q. Are there any other sewers discharging, besides this trunk sewer outfall you are speaking of, into the Potomac River north of that trunk sewer outfall?

A. No, there are practically none, there are a few houses along the shore above the city, but there is very little discharge of sewage; it is a negligible quantity.

3403 Q. Then what organic matter do you say lowered the oxygen contents of the water before it reached your outfall and the neighborhood where you make your determinations?

A. If the river only had a draft on it from the sewage for reducing its oxygen, there would not be any; but all the processes of nature are using up oxygen and we have organic matter to be decomposed in very large quantities other than that of sewage; that work must be going on in all streams.

Q. What organic matter besides the sewage, that you know of, is being decomposed there in the river that lowers its oxygen contents on some occasions to 60% of the saturation point?

A. The 60% that you refer to is the percentage of oxygen in the dilution basins after the application of the sewage.

Q. And outside of that basin am I correct in saying that it never goes below 80%?

A. No, I think not; I think it has gone below 80%.

Q. Of your own knowledge do you know how much lower than 80% it has ever gone?

A. I have not the figures here; my recollection is, of the averages during the past year to which I have referred that it goes as low as 70%; that is, river water above the influence of the sewage discharge.

Q. Who makes the oxygen determinations for the sewage disposal system of Washington?

A. They are made by our chemist.

Q. Have those figures ever been published?

A. Oh, yes, they are published in my annual report every year, not all of the figures, but a summary of them and quite a number of figures, as much as we can give space for.

Q. Have you made any bacterial determinations for the water in the vicinity of the outfall or above the outfall?

A. We have not.

Q. What becomes of the organic matter discharged into 3404 water; how is it finally disposed of?

A. It is transformed by bacterial influences, it becomes into inorganic matter.

Q. With a high average like 80% in the neighborhood of the outfall did it occur to you that this bacterial or biological disintegrating process took place lower down the river than the territory covered by your commission?

A. From examinations made, oxygen determinations made, below the outfall, and on down the river for quite a considerable distance, we did not find that to be the case. In fact it was by a process of observation of that sort that we determined points for taking our samples, having, of course, reference to convenience and minimum distances of travel for that work.

Q. Is it not a fact with that head in the sewer it might be considered a rapid discharge of the sewage and being discharged into a river whose velocity you state is about three or four miles, does it not occur to you that the sewage is transported quite a distance below the city before these biological changes have an opportunity to begin?

A. In answer to that I would say, in regard to river velocities, the question I was asked was what was the maximum velocity at ebb tide. As a matter of fact, at the outfall we have substantially as much current, or as long a period of flow, on the flood as on the ebb and the sewage at outfall oscillates with the tide through a number of cycles before any particular part has finally passed below the point of actual outfall.

Q. Of actual discharge?

A. Of actual discharge.

Q. Have you conducted any float observations to determine that fact?

A. We have.

Q. How long does it take the Washington sewage after its discharge to go below the point of discharge on a flood tide?

3405 A. That would have to be qualified by a statement as to the time during flood tide when the discharge occurs, that

occurring near the end of a flood tide would have a very different history than that occurring at the beginning of the flood tide.

Q. Give both, you have taken float observations to determine that fact?

A. Perhaps the clearest answer I could give to that would be the range of tides, in number, that is the maximum and minimum number, that we have found covered that period of oscillation. I think our minimum number of tides is four, our maximum number about double that, about eight or nine tides.

Q. What do your average observations determine for you with regard to the length of time it takes this sewage to pass the point of discharge on a flood tide?

A. That is the average time?

Q. On a flood tide.

A. I do not think really I can answer that question as it is put. If you mean the average it would be one answer because not only do we have the tide, but we have the condition of the river flow as a factor in that. As I stated, the range of discharge under normal conditions, that is, within the range of normal conditions, is from four to eight tides to pass clear of the outfall.

Q. Do you know whether or not there are deposits from your sewage at Washington below the point of discharge, sewage sludge such as you have described—

Mr. Riker: I object to the question because he has not described any sewage sludge in the river; on the contrary, he said there was not any.

The Commissioner: Note the objection of defendants' counsel.

A. None of our examinations have shown any sludge deposits whatever.

Q. At any point?

A. At any point. From an examination of the river below, I mean for very considerable distances below, covering a reach perhaps of thirty or forty miles of river, not however by examinations through taking samples of the river bottom, but from other evidences I would certainly conclude there were no solid deposits chargeable to Washington sewage after the screening of our sewage and after the sedimentation and after the pumping.

Q. Have you not described it as being very finely comminuted when it gets to the outfall?

A. Yes, sir.

Q. What evidence have you to support your contention that there was no indication along the shore of gross parts of sewage; there was no evidence of gross sewage pollution that you saw along the shore as I understand it?

A. The examination I referred to, of course, was not with the idea of finding any large masses of sewage, but we have a tidal range of about three feet with a considerable shore exposed at low tide and of course a considerable reach beyond that exposed at the ordinary high tide and we see the effect on the shore by the deposits of the receding tide of even very small particles of organic matter;

the first indication of that would be odors, it would have a very disagreeable effect on the sense of smell, at low tide especially in hot weather, in the summer time. It is rather such indications as that we rely upon to determine whether we are doing any injury along the shore in that respect.

Q. Do you know as a matter of fact that several complaints have been lodged with the Governor of Virginia and the matter is now being agitated in the legislature of Virginia so as to secure measures to abate the nuisance caused by the sewage of Washington city?

3407 A. Not at all along the line we have been speaking of:

The matter before the State of Virginia has nothing to do with that and absolutely has no foundation in the way of local complaint. If I might state what the situation is—the Pure Food Board of the Department of Agriculture has condemned some Potomac oysters and this has aroused a great deal of activity and indignation of the part, of course, of the owners of the oyster beds and there is now a biological survey being started by the Public Health authorities, the Marine Hospital service, that has been started on my recommendation and to which I made some reference in my last annual report, to determine whether, at a distance of from eighty to one hundred miles any effect that the Pure Food experts may find in the way of Typhoid fever germs, disease bearing germs, either within the oysters or within the waters in the vicinity of the oyster beds is due to the Washington discharge of sewage. That is a very much mooted question just at present and we are going to make a very thorough survey that will take a year or more, with samples taken frequently, to determine that. But that is a very remote thing.

Q. Have they not found very large deposits of sewage from Washington sewage that was suffocating these oysters?

A. Absolutely no, sir.

Q. Have they not made that complaint?

A. I never heard of such a complaint?

Q. What provision in your sewage disposal system is there for the removal of organic matter in solution?

A. Before discharge?

Q. Before discharge.

A. Of organic matter in solution? None.

Q. What provision have you made in your sewage disposal system for the removal of colloidal matter before discharge?

A. None.

3408 Q. What provision was made in your sewage disposal system for the removal of pathogenic germs before discharge?

A. Perhaps I might say none to that; but we really have done something, we have constructed on hospital discharges automatic disinfecting plants for the sewage; we have built two of those for hospitals coming under the control of the District Health Officer, the Health department of the District, with that exception, none.

Q. So that you don't really know whether their complaint would be well grounded on the idea that they were getting typhoid infec-

tions from your sewage, that is one of the easiest ways of getting it, from the oysters; that is the complaint, is it not?

A. No, the complaint is a little more complex than that. The people in the district eat the oysters but the people who are complaining are the owners of the oyster beds who have had their oyster beds condemned; not many of them, but some of them. I might say in regard to that a good deal more, the department of Agriculture itself across their map have put a line, a zone, where oysters are not safe to take, not due to any effect of sewage discharge or any disease bearing germs on those oyster beds as determined from observations but from samples of water and samples of oysters, purely of course, in the way of typhoid germs; and below that they make the oysters absolutely safe. The part they mark as being dangerous, and that is the way they mark it on their chart, is the very upper edge of the oyster beds; so far as the district is concerned, those beds are from eighty to a hundred miles below the river with the nearest bed, that is the upper fringe, with a very few oysters, sixty miles below, apparent to anyone entirely too far away to be effected by any deposits from the sewer. But they do not condemn

3409 the oysters from the river, they simply mark out those spots as dangerous, but they do not condemn the oysters from that area; they take samples of the water and if they find a cargo of oysters at the wharf they take some samples to the laboratory and if they find a germ they condemn the cargo. Oysters are coming to us all the time from the Potomac and are passed by the Pure Food Board.

Q. Is Dr. Sloan not one of those in charge of that?

A. Yes, sir.

Q. Have you any doubt that on an ebb tide your sewage effluent will go over those oyster beds?

A. Absolutely none.

Q. You have none?

A. No, there is no sewage by the time it reaches the oyster beds, it has gone in the wash; it has, as I say, about eighty miles to travel.

Q. Are you familiar with the biological processes by which it is disintegrated?

A. Not as a biologist.

Q. Are you a bacteriologist?

A. No, sir.

Q. Have you any idea of the length of time it takes under favorable conditions, with an ample supply of oxygen, to disintegrate organic matter?

A. That would depend so much upon so many circumstances that I don't think it is possible to give an answer. I am giving favorable conditions, fresh water conditions.

A. Ample oxygen?—And of course the material being acted upon must be in such a condition as to give the most favorable opportunity for action. For instance, masses of organic matter must be broken up at first by slow processes before such action can take place. It is a very difficult thing.

Q. What familiarity have you with the Upper Bay outside of what you have testified to?

3410 A. You mean here in New York?

Q. New York Upper Bay?

A. I have practically only such as I have testified to.

Q. What is the depth of the sludge deposits in New York Upper Bay?

A. I could not state that; I have read figures on the subject, of some examinations that have been made.

Q. What is the condition of the oxygen contents of the East River between 42nd Street and the Battery?

A. That I could not state; I have read the results of investigations but I cannot recall them.

Q. How low would you think it would go?

A. Average or maximum or minimum?

Q. Minimum.

A. I suppose it would go down below 50 for the minimum.

Q. Do you think fish could live in a river with the oxygen contents at fifty?

A. If they do not stay there all the time, sure.

Q. If they stay a little while they might live in it?

A. Oh, yes, easily enough at fifty; I doubt very much if it would affect the fish because it is not uniform and it is not constant. A great many figures have been given, perhaps they are all guesses, as to how low that oxygen per cent falls before it is a determined fact that fish will not live.

Q. Have you had any experience with fish and oxygen outside of Washington where you say fish can live in oxygen contents of 89% and are caught there?

A. Oh, yes 60%.

Q. You have caught them when the oxygen contents in the Potomac have been 60?

A. Yes, sir, they are fishing there right along with the oxygen contents at 60.

Q. And it is quite frequently as low as that?

3411 A. We have it at times.

Q. And that would be in the neighborhood of the outfall, would it?

A. Yes, sir, right there close to the outfall.

Q. How low an oxygen percentage can fish live on?

A. That would depend on conditions, whether it was continuous, whether it was variable in different portions of the volume of water in which the fish are living, whether it remained constant at that percent or varied. It always appeals to me to be a very clear comparison with ourselves, that we can live in a room with mighty bad air for a time if we can get out in the fresh air, and a good many of us have to at times; and we live for days in out-of-door air in the country air; then we have the city air and we have the close air of rooms and then too we have the bad air of closely crowded rooms. The same kind of experience it seems to me could be applied to fish life as to human life.

Q. Can fish live in water where the oxygen never rises above 50% of its saturation limit?

A. That I don't know.

Q. What is the percentage of the oxygen contained in the Passaic River at ebb and flood?

A. I don't know that, it must be very small.

Q. Would you call 37% small?

A. As an average?

Q. Yes.

A. Yes, sir, small.

Q. What occasions below the oxygen contents of Passaic River as against the Potomac River?

A. They put too much of a burden upon it, it is carrying more than it can carry.

Q. Do you know what the tidal conditions are in the Passaic River?

3412 A. Do you mean what is the range of tide?

Q. Yes.

A. I don't know it in feet, no.

Q. Do you know what the depth of the river is?

A. No, I have seen it at different sections but I could not recall in feet what the depth is.

Q. Do you know what manufactories discharge trade waste into the Passaic River?

A. I could not answer that; I have seen some statements of it, but I don't know, I am not familiar enough with the local conditions to give a statement of it.

Q. There are a large number, would you say?

A. I would say there are a great many.

Q. And they discharge considerable organic trade waste?

A. I should say so, yes.

Q. And considerable spent liquors?

A. Yes, sir.

Q. Are you familiar with the effect of spent liquors upon waters in which they are discharged?

A. That is not a type of discharge that I have had any direct experience with.

Q. Do you know of the condition of Monongahela River, the discharge of acid wastes?

A. Yes, sir.

Q. Do they not destroy the bacterial forms of life that you say disintegrate organic matter?

A. They are supposed to be injurious to them.

Q. Do they absolutely destroy them?

A. Yes, sir.

Q. Have we many of those acid wastes in the Passaic River?

A. I do not know.

3413 Q. Do you think it is a fair comparison; considering the large amount of trade waste and domestic sewage contemplated to be carried by the Passaic Valley Sewage, do you

think it is a fair comparison with the Washington city, which is practically entirely residential?

A. Of course there is that difference; at the same time there is a much better natural vehicle for dilution here than in Washington.

Q. Why?

A. It is much larger and more effective, at the point of discharge proposed by the Commission, in my judgment. As to the matter of trade wastes, I do not think that is really, from an engineering point of view, nearly as serious as it is made out because it is up to the people who have to deal with the sewage to require those having such trade wastes to take care of them, to specially provide for them, so as not to make them an unreasonable burden on the sewerage system.

Q. What provision is made in Complainants' Exhibit No. 135 that would eliminate thereby trade wastes from the effluent?

A. There is none so far as I can recall.

Q. What provision is there for the elimination of organic matter in solution from the effluent?

A. Before discharge?

Q. Yes.

A. There is none so far as I know of.

Q. What provision is there made in the stipulation, Complainants' Exhibit No. 135 for the elimination of pathogenic germs from the effluent before its discharge?

A. None, so far as I know of.

Q. I think you said that in your plant down there in Washington you made about five to ten minutes' sedimentation?

A. Yes, sir.

Q. That is rather short, is it not?

3414 A. Yes, sir, and still we get a very large amount of sedimentation in that time.

Redirect examination by Mr. Riker:

Q. Are pathogenic germs more likely to be carried by domestic sewage or trade wastes?

A. By domestic sewage.

Q. Provision for the removal of organic matter you say is not contained in this stipulation, Complainant's Exhibit 135?

A. I do not think the question was as to organic matter, if it were my answer was incorrect.

Q. Organic matter in solution?

A. Yes. I take it that means exactly what it says and I do not find that there is any provision for the removal of that.

Q. Will you explain just what you understand by organic matter in solution?

A. It would mean the organic matter that remains after careful sedimentation, screening and skimming in such fine particles as not to be removable by those means, and in such condition as to be readily and efficiently acted upon by the dilution.

Q. Do you find in the stipulation which is Complainant's Exhibit 135 a provision for the removal of organic matters?

A. The processes as set forth in that stipulation certainly provide for the removal of organic matter.

Q. You say you find, as I remember your testimony on cross examination, that in the stipulation in question there is no specific provision for the removal of acids and other trade wastes, as such, am I right about that?

A. That was my statement.

Q. In the guaranteed results, if they are produced, in your opinion is it necessary to remove these trade wastes and 3415 deposits in order to produce the results guaranteed?

A. It would be necessary to remove them or to so reduce them as to effect the results covered by the guarantee.

Q. Could or could not that removal be accomplished either at the disposal plant itself or at the point of production of the trade wastes?

A. It is very possible that it could be accomplished at either point, with probably a more effective result at the point of reduction.

Recross-examination by Dr. O'Sullivan:

Q. Do you make any distinction between septic sewage and fresh sewage, in their disposals?

A. Oh, yes.

Q. Are you in favor of a trunk sewer, a long trunk sewer, say twenty-six miles long, rather than local disposal at the point where the sewage is created, as it were?

A. I certainly am, and I might state in that connection something about our work at Washington. We have a very large population that is growing in two comparatively small stream valleys outside of the district whose only discharge is into those small streams that flow through a park in the District of Columbia. We have gone to a very great expense to prevent the disposal of any sewage into any of these streams, in a very large area and we are now formulating a plan by which we propose to take into our sewage system the sewage of the towns and communities lying in that territory, outside of the District, in the State of Maryland; that would require a construction, beyond our lines, of about ten miles in each valley, roughly. Meanwhile, our sewage is flowing through our sewers; some of it has to come about twenty miles before it gets to our plant and that would add some three miles that we have yet to build to reach the District which runs ten miles be- 3416 yond, thus adding thirteen miles in length to our system.

We have come to the conclusion that we can safely take care of that and discharge that sewage, as fresh sewage, into the Potomac, from our experience in handling the sewage that travels through our own system, quite a distance, as I say, up towards twenty miles.

Q. Would this sewage be of the same character as the sewage we are now dealing with, namely, residential or house sewage?

A. That is very difficult to predict; I should say that it would be very largely, at the same time there is a tendency owing to lower taxes and freedom of restraining influences existing in the Capitol to the development of manufacturing concerns outside, along the

borders of the District, to put such development in this territory so that we would probably begin to get a different class of sewage from our own.

Q. How old would that sewage average when it got to the out-fall?

A. I suppose our average sewage would be just about what they have here in the Passaic Valley, I should — eight or nine hours.

Q. What is the grade contemplated for the Passaic Valley Sewer?

A. That I cannot tell you offhand, I have seen it but I cannot remember.

Q. Can you tell the age of the sewage that travels a long distance without knowing the grade of the sewer?

A. No, but I can be at it all day and remember what I get as a result; I remember the result but not the details. I figured it out as taking eight or nine hours, taking quite a number of different figures, the length, the grade, and so on, and I cannot recall
3417 the origin of the result I reached now, all the proportions along the line, but they are given I think in one of the Passaic Valley reports, if I remember correctly.

Q. How many of the Passaic Valley reports have you seen?

A. Indeed I don't know, I have seen several of them.

Q. You have?

A. Yes, sir.

Q. More than two or three?

A. Oh, no, I think now. Well I don't know as you call them all reports, I have seen one, and perhaps the earliest and some partial reports, one I remember was in pamphlet form and I think that was the latest one, if I remember correctly.

Q. Which was the first one?

A. It seems to me the earliest one is rather a large volume, rather a long one; I cannot recall the year now, I did not make any special note of it.

Q. Have you seen the plans and specifications for the trunk sewer project?

A. I have.

Q. And the *the* sewage disposal system?

A. That is their pumping plant and sedimentation plant?

Q. Yes.

A. Yes, sir, I have.

Q. And you have studied those various plans?

A. Yes, sir.

Q. Can you state any facts in relation to the sewage disposal system that differ from your Washington plant?

A. In detail it is quite different from the Washington plant. In the Washington plant, taking sedimentation first, we have a single sedimentation chamber somewhat larger than the grit chambers as indicated on the drawings for the Passaic Valley plans, and that is all the sedimentation we have, whereas, with the plant here the plans show grit chambers through which the flow goes after
3418 passing the coarse screens, then it goes through the pumps, then through the sedimentation basin where there is a very

considerable period of time allowed, an hour I believe as a minimum and an hour and a half as an average as I recall it, for the deposit of material held in suspension. Then as to the screens, we have double sets of coarse screens, what are generally known as coarse screens, that is, gates with bars that really present a series of slots through which the sewage must pass, whereas in the Passaic Valley plant they provide for very fine screens.

Q. How long is the trunk sewer?

A. The Passaic Valley trunk sewer?

Q. The Passaic Valley trunk sewer.

A. Do you mean from the point of outfall to the upper limits?

Q. From the head of the sewage system.

A. I think it is about twenty-five miles.

Q. And you have no idea of the grade?

A. I cannot recall the grade, I have seen it.

Q. Would you say whether it is a slight or whether it is a heavy grade?

A. A grade is such a variable thing; to an electric railroad man a grade is one thing and to a steam railroad man it is another; it depends on what you call a heavy grade.

Q. We are speaking of a sewerage system.

A. We think our outfall sewer has a good grade at a rate of one in thirty-six.

Q. And would the Passaic Valley have a lower or higher grade than that?

A. I think it is heavier.

Q. You think it is?

A. That is my recollection.

Q. You are familiar with the land along the Passaic
3419 water shed?

A. Yes, I have been along the river.

Q. What extent of territory is it contemplated to serve by the Passaic Valley plant?

A. In area?

Q. Yes.

A. I think about one hundred miles approximately.

Q. And what population?

A. The current figures as I recall them are about seven hundred thousand.

Q. Do you know whether it is more than that?

A. I do not, I do not recall exactly; it is in the neighborhood of seven hundred thousand as I recall it. I am speaking now of the present population in the Valley.

Q. I understand you studied these plans to determine their efficiency to accomplish the stipulation set forth?

A. Yes, sir.

Q. What population will that trunk sewer scheme serve in 1940?

A. That is, what is the estimated population in 1940 in the Passaic Valley?

Q. You say you have read their reports?

A. Yes, sir.

Q. And you have studied this project.

A. Yes. Well you see it is a pretty difficult thing to make answer to some of the questions because I think the report as early as 1903 gives a population of, I think, as low as five hundred thousand. I have seen some later figures and I cannot recall whether they are the 1912 figures or not, and I remember they are in the neighborhood of seven hundred thousand.

Q. Do you remember whether some populations were shrunk with the view of affecting the contractual relations with the Passaic Valley Sewerage Commissioners?

Mr. Riker: Objected to as not cross examination on anything this witness has testified to and as immaterial and irrelevant in any view of the case.

The Commissioner: Note the objection of counsel for the defendant.

A. I do not.

Q. Do you know whether those populations that would read in 1903 as estimates were grossly below the actual populations in 1910, although they were estimated for 1940?

A. All the populations to which I have referred were not estimated for 1940; they were the existing populations at that time.

Q. What was the first estimate for the year 1940 that you have read from the matters that have been submitted to you in relation to the Passaic Valley Trunk sewer project?

A. The estimate of the earliest date I cannot tell, I do not recall because I did not make any notes from it.

Q. Were the plans and specifications presented to you designed to merely serve the present population?

A. Oh, no.

Q. What distance in the future did they extend to?

A. I believe to 1940.

Q. And to serve what population?

A. I cannot recall. My recollection as to quantity I can recall a little more definitely perhaps, although I am not clear at all on either one.

Q. What number of distinct and separate communities does this Trunk sewer project of the Passaic Valley Sewerage Commissioners design to serve?

3421 Mr. Riker: I object to the question on the ground that "communities" is not a definite word which this witness can understand and apply and answer to.

The Commissioner: Note the objection of defendant's counsel.

A. I cannot state.

Q. Do you know the character of the trade wastes from the different communities and what effect they would have on domestic sewage coming from these communities?

A. No, I do not think I can answer that question.

Q. What other trunk sewer project have you ever had submitted

to you beside this prospective one of the Passaic Valley Sewerage Commissioners?

A. This is the only one.

Further redirect examination by Mr. Riker:

Q. Have you made any examination of the Boston system?

A. I certainly have.

Q. Is that a trunk sewer system?

A. Yes, sir.

Q. Have you had any experience with the Washington system?

A. I certainly have.

Q. Is it a trunk sewer system?

A. It certainly is.

Q. Are there any others that you have examined?

A. Oh, yes, I examined systems in a number of cities, as I have testified to.

Q. Then exactly what did you intend when you said that you had had no plans submitted to you for other systems?

A. I understood the question to be whether I had been called upon in advance of construction to express an opinion as to the feasibility of a sewage disposal system such as this.

Further recross-examination by Dr. O'Sullivan:

Q. Were you called in consultation here, in advance of
3422 construction, to pass upon these plans and specifications?

A. No; I was asked to examine the plans and go over
them and to examine the situation, not in advance of their preparations.

Q. Do you recall your examination of these plans?

A. Yes.

Q. How many by passers are provided for the sewerage before
it reaches the disposal works on the Newark meadows?

A. I have to ask you what you mean by by passers.

Q. Is that term unknown to you as a civil engineer?

A. Oh, no, but I do not understand its relationship to these plans.

Q. What is a by-pass as you understand it?

A. There are a great many different kinds; we would have a by-pass for storm water, for the separation of sewage from storm water; we would have a by-pass to carry discharge from one channel to another other than the regular channel, to effect perhaps a different discharge, or to pass through different forms of construction. It just occurs to me that the term, as you use it, is not a term such as we use; I may be in error, but I imagine you mean the number of storm water outlets from the combined systems that would pass into the river, along the lines of this intersecting sewer. Perhaps you didn't mean that, I don't know; I am just guessing at it.

Q. Assuming that is the meaning, have you found in these plans any provisions for by passers which would let the sewage and storm water pass to the Passaic River and into Newark Bay?

A. That is, the discharge of the storm water and sewage within this interceptor?

Q. From the interceptor.

A. None, I don't know of any.

3423 Q. Will you say that there are none in the plans?

A. I don't recall any.

Q. Would not that be an essential matter for you to take into consideration if you had to pass on the adequacy of this whole system?

A. Not at all, I don't think it would affect it at all.

Q. What would be the advantage of a by-passer?

A. We have them along out interceptors for removing the flow temporarily from the interceptor for repairs or examination or some special work that we could not do while the interceptor was working.

Q. And while the sewage is going through the bypass, it receives no treatment, is not that correct?

A. When it goes through the by-pass it does not receive any treatment. That of course is not a constantly recurring or an often recurring condition; that is a condition that would occur at very remote periods, that is I mean we utilize the best conditions of weather and all that sort of thing when we have to resort to such an expedient to get at the work.

Q. In your redirect examination you were asked about trunk sewers; do you know of any trunk sewer that serves more than one community, that has been submitted to you?

A. Oh, yes, I think our trunk sewers in the District of Columbia serve more than one community.

Q. Is that a homogeneous community in the District of Columbia?

A. Well, it is under the same general government.

Q. Is that trunk sewer in esse?

A. Of course, it comes under the same law——

Q. Does it exist now?

A. Oh, yes.

Q. There is a trunk sewer serving the whole of the District of Columbia?

3424 Q. Well, there are several of them built and serving the separate communities within the District. The District of Columbia is not made up of one solidly built-up city, if it were it would be as big as New York.

Q. Does your sewage disposal system take care of the entire sewage of the District of Columbia?

A. Substantially, yes.

Q. Does that differ from a trunk sewer project that serves a large number of communities with varying trade wastes, varying manufacturing interests and differing in location?

A. In the last element, the differing location, I think we have a corresponding condition; the question of different trade wastes does not seem to me to have any effect upon the question.

Q. Have you ever had anything to do directly with trade wastes with regard to sewage disposal?

A. I think I so stated, that we had some trade wastes at Washington, but very little.

Q. Yes, plate printers' ink?

A. And slaughter houses, dyeing houses and plants of that sort; it is not large; it is comparatively small.

Q. I understood you to say it was almost negligible?

A. I may not have caught the gist of your question.

Q. What I am trying to get at is this:

In the Washington situation you have a homogeneous community with substantially residential sewage; in Boston you have a homogeneous community with trade wastes and with domestic sewage; in the Passaic Valley Trunk Sewer project and you have a large number of radically different manufacturing interests and radically different trade wastes; I asked you if you knew of or had submitted to you any such trunk sewer project for the disposal of such a complex system of waste and sewage?

Mr. Riker: I object to the question on the ground that it contains a number of facts that are not shown to this witness
3425 to have any existence and this question is an expert question or a hypothetical question, the basis of which is not proved in this case.

The Commissioner: Note the objection of defendants' counsel.

A. I have not, but in explanation of that I would like to state that it is not apparent to me, the meaning of the term homogeneous communities as applied to the metropolitan district of Boston and as distinguished from the Passaic Valley District. It appears to me that the two conditions in that respect are very largely, if not precisely identical.

Q. Are there any silk mills in Boston?

A. That I cannot answer.

Q. Are there any woolen mills in Boston?

A. I cannot answer that.

Q. That discharge their trade wastes into the sewage system?

Mr. Riker: If you mean the two are of the same character it is admitted on the record; if you mean to say they are identical that is not admitted.

Q. Are the sewage problems of any two communities identical?

A. Probably not precisely.

Further redirect examination by Mr. Riker:

Q. You were asked about the submission of the plans and specification- of the Passaic Valley Sewerage Commissioners, to you; were they submitted to you for the purpose of getting your judgment or opinion as to the practical application of those plans and specifications or only for the purpose of familiarizing yourself with them for the purpose of testifying in this case?

Dr. O'Sullivan: Objected to as calling for a *physic* process on the part of this witness which is clearly not compatible with the posi-

tion of the witness; he cannot tell by any means known to
3426 the witness what the mental processes of those submitting
the plans to him were, what they had in contemplation and
what their purpose was.

The Commissioner: Note the objection of complainants' counsel.

A. I was asked to examine those plans in connection with my appearance as a witness in this case.

Q. How long ago?

A. I think about ten days ago.

Q. And that was the time when they were submitted to you?

A. That was the first time.

Q. And your interest in this case is just about ten days' old?

A. Just about.

(A recess was then taken.)

After Recess.

Mr. Riker: I desire to call Mr. Philip.

The Commissioner: Very well, then the witness may take the stand.

ASA HENRY PHILIPS, resumes the stand.

Further direct examination by Mr. Riker:

Q. I have understood from you that you had special occasion for inquiring into the condition surrounding the outfall last September, will you state what they were and what your observations were at that time?

A. Well, I think you refer to a great many trips we made to the outfall with engineers and others who were in Washington attending the Fifteenth International Congress of Hygiene and Demography and in connection with an exhibit at that Congress we had a section of one of our largest trunk sewers, about a half a mile in length, open for inside inspection—station inspection, and we made
3427 with our boat—our launch—trips to the outfall taking those
who cared to go to see the conditions there.

Q. Do you know Dr. Soper?

A. I do.

Q. Is he one who went there?

A. He was.

Q. Was the launch high above the water, or—

A. Oh, no, just a gasoline launch, rather low over the water.

Q. Where did you go on that water trip in your launch?

A. We made the trips from the pumping station in the city to the outfall down the river.

Dr. O'Sullivan: What city was this?

Witness: Washington, D. C.

Q. And at the outfall, what did you do?

A. We would bring the boat around as nearly as possible directly

over the five foot diameter pipe which was discharging sewage down in about twenty-eight feet of water so that they could see, with as near-sighted a view as you could possibly have, what the condition was—*right* and smell.

Q. Was there odor on that trip?

A. There was on one of the trips, yes.

Q. Did you take him over the outfall?

A. We did.

Q. Did you observe any odors at that point at that time?

A. I did not.

Q. Did you see any evidence of suspended particles, solid particles of sewage?

A. No, I think none at all.

Q. Who else was on that trip, will you recall as many as you can?

A. We made quite a good many trips, of course, at various times and I might be astray as to one or two of those who were on that particular trip; I think we had, Mr. Herring, Dr. Soper,
3428 Mr. Webster of Philadelphia, one of Mr. Weber's assistants, and Dr. Tribus, I think he was the consulting engineer for the Borough of Richmond, and perhaps one or two others.

Q. You were asked to give the average age of the sewage that would be discharged from the Passaic Valley Sewage system and I think you said eight hours, about?

A. Yes.

Q. Is that septic sewage?

A. Oh, no.

Q. The intercepting sewers in Washington, are they designed to accommodate the estimated population at any time or are they designed for a surplus capacity?

A. Always, I think, it is the uniform practise that they are designed for a large surplus capacity. If we take the actual completed capacity of the sewer itself it would be 100% in excess of the actual designed capacity for the necessities.

Q. Have you made observations sufficient in your opinion to justify you in testifying upon the condition of the discharge of sewage in the city of New York along the East River as to whether or not it is in any sense prepared for dilution?

Mr. O'Sullivan: Objected to as calling upon this witness to pass upon his own capacity.

The Commissioner: Note the objection of counsel for the complainant.

A. I have observed the discharge and it is certainly absolutely unfit and unprepared for a process of disposal by dilution.

Q. What do you observe as to the character of the sludge accumulated in your sedimentation basin at Washington?

A. It contains a very large amount of organic matter. Of course it is not possible to trace all the sources, it is possible to trace one very perceptible source, and that is manure from the streets,
3429 that would be one item; it contains that material which if it were discharged in an unaided state, I mean discharged

without sedimentation, if it passed out into the channel would settle to the bottom of the channel and there build up a solid mass which would have a bad effect in two different ways, it would not only take an undue amount of oxygen out of the water but it would generate objectionable gases which have a tendency very often to bring up masses of this material to the surface, and then forming a deposit of organic matter that is almost, in a way, indestructable; it cannot be reached except it goes through this process of fermentation to break it up, it cannot become broken up and disorganized as organic matter and produces offensive odors, the most objectionable feature altogether of any sewage discharge in water for its dilution.

Q. Is or is not that particular variety of organic matter removed by a process of sedimentation?

A. Yes, sir.

Further recross-examination by Dr. O'Sullivan:

Q. You used the term "septic sewage" in answer to a question of Mr. Riker, will you define what you mean by "septic sewage"?

A. It is what we might term stale sewage, it is sewage in which processes have been begun which create gases perhaps and create objectionable odors; it is offensive sewage, fresh sewage is not offensive.

Q. Do you make any distinction between stale and septic sewage?

A. Not in the sense in which I have just been speaking.

Q. In any sense, as a sanitary engineer?

A. No I do not know that I would.

Q. Is there any one factor that will determine whether sewage is septic or not?

A. One quality of the sewage itself do you mean? I do
3430 not understand what you mean by factor?

Q. How would you determine whether or not sewage was septic?

A. We determine largely by odor and by color, that would be the most ready way to determine.

Q. Sewage could not be septic if it did not have what you describe as offensive odors, is that true?

A. Yes, I would go pretty close to that, I would stand on the odor.

Q. And you make no distinction between stale and septic sewage?

A. No, not in the way in which we are speaking of it.

Q. What is the age of sewage on Manhattan Island as it reaches the discharge point?

A. I suppose the average age is possibly fifteen minutes, something like that, it may be a little more than that but I do not think it is very much.

Q. Would you call it fresh or septic?

A. Oh, fresh. I suppose that ought to be qualified. That is the sewage itself; I doubt very much if the actual discharge into the river, particularly discharges from sewers on Manhattan Island

during the time of rain, where the accumulated sludge deposits that have remained within the sewers are brought out into the river, is fresh sewage by any means.

Q. Do you know what the grade of those sewers is?

A. They are all generally very good grades, the precise figures I do not know.

Q. A pretty high grade so as to have a pretty rapid discharge?

A. But they are tide-locked some of them, they have pretty heavy sludge deposits within the sewers themselves.

Q. Have you ever seen any of those deposits?

A. I have not.

Q. How do you know they have such deposits?

3431 A. I have got most of my information from the reports of the New York Sewage Board.

Q. I do not know of any such board; perhaps you mean the Metropolitan Sewerage Commission.

A. The Metropolitan Sewerage Commission I should have said, yes.

Q. Would the oxygen contents of sewage play any part in its classification?

A. Yes.

Q. Would you expect to find oxygen in fresh sewage?

A. Yes.

Q. Where was the sludge which you spoke of, these sludge deposits that you gave your answer concerning?

A. You mean in the Manhattan sewers?

— No, in answer to Mr. Riker; I did not get the location.

A. In the sedimentation tanks?

Q. In Washington?

A. In Washington.

Q. Do you make any distinction between the products of aerobic and anaerobic decomposition?

A. Yes.

Q. What are the processes of anaerobic action?

A. To really give an answer to that is a little more perhaps than I would be willing to undertake, I am not a chemist.

Q. And you are not a bacteriologist?

A. No, sir.

Q. Is sulphuretted hydrogen one of the products of anaerobic decomposition?

Mr. Riker: Sewage you mean?

Dr. O'Sullivan: Organic matter.

Q. Can there be any anaerobic decomposition of inorganic matter?

A. No, sir, I should say not.

3432 Q. So you understood organic, did you not, when I used the term?

A. Yes, sir.

Q. What effect has sulphuretted hydrogen on shell fish?

A. I do not know, I cannot answer that.

Q. Is not that one of the complaints that has been made by the authorities of Virginia against the sewerage of Washington that sulphuretted hydrogen is destroying the oysters?

A. I never heard of it, no, sir.

Q. The only complaint you heard of was where they suffered some typhoid infection?

A. That was not the complaint, the complaint was altogether due to the condemnation by the Pure Food Board of the Agriculture department.

Q. That these oysters were unfit for food?

A. Yes, sir.

Q. Why?

A. Purely and only, I think, on account of typhoid.

Q. And do you not know the effect of sulphuretted hydrogen upon shell fish?

A. No, sir, I do not.

Q. And sulphuretted hydrogen is one of the products of Judge decomposition, is it not?

A. Yes, sir.

WILLIAM M. BROWN, a witness on behalf of defendants, being duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. Riker:

Q. Where do you reside?

A. In Newark, at present.

Q. What is your profession?

A. Civil Engineer.

Q. Are you a graduate of a university?

A. Brown University.

3433 Q. What class?

A. 1873.

Q. Do you specialize in your profession?

A. My work has been largely in connection with sewerage construction and operation.

Q. Are you a member of any of the scientific societies of this country?

A. The American Society and the Boston Society of Civil Engineers.

Q. In your work of construction and operation of sewers where have you been engaged?

A. In the city of Providence, the city of Boston, on different drainage works, for most of my life on the metropolitan sewerage work of Boston.

Q. How long were you engaged with the metropolitan sewerage commission at Boston.

A. Their work started in 1890 and I was on their work and on the sewerage work until last March.

Q. Have you been in the employ of the State Board of Health of Massachusetts in any connection?

A. I was employed by them on preliminary studies leading up to the Boston metropolitan work.

Q. Any other boards, in that connection?

A. The Massachusetts Drainage board.

Q. You were associated you said from 1890 until last March with that enterprise?

A. Yes, sir.

Q. What positions have you held in that enterprise?

A. I was assistant to the Chief Engineer until 1895 and from 1895 until I came to Newark I was Chief Engineer and had engineering control of the work until I left.

Q. What is your engagement now?

A. I am chief engineer of the Passaic Valley Sewerage
2434 Commissioners.

Q. When did you take that position?

A. Last March.

Q. March, 1912?

A. Yes, sir.

Q. What territory is served by the metropolitan sewerage commission of Massachusetts?

A. The works provide for the main drainage of about 300 square miles of territory surrounding the city and involving parts of the city area.

Q. Does it include any other municipalities or parts of any other municipalities than Boston?

A. It takes in twenty-five.

Q. Do you know what the present population is?

A. Approximately a million, something over nine hundred thousand I think.

Q. Do you know what the cost of the work is up to the present time?

A. Sixteen million dollars.

Q. How is the sewage in this area which you have mentioned disposed of?

A. It is disposed of by dilution in the waters of the outer harbor at points about four and a half miles below the city, two points, one north of the city and one south.

Q. How many actual points of discharge are there, how many outlets?

A. One at each point.

Q. Do you mean by that there are two outlets?

A. Two outlets.

Q. Taking the north outlet, at what tide does the discharge occur?

A. It is continuous, it is discharging all the time.

Q. At the north?

2435 A. And the south the same way.

Q. What is the average daily discharge at the north outlet?

A. About sixty millions, the average, it is as high under flood conditions as 160.

Q. And on the south? What is the character of that discharge?

A. Forty million to the average, and as high as 140 at the maximum, at flood times.

Q. Is there any difference as to the handling of the sewage at these two discharges?

A. Practically the same except that on the north side the discharge is at low water of the harbor and on the south side it is at a point thirty feet below low water of the harbor.

Q. Is there any difference as to detaining the sewage for any period in either of these outlets?

A. It is the same, it is continued.

Q. What process of purification or partial purification is the sewage subjected to in either of these outlets?

A. There is no treatment given to it on either of the discharges. Screens intercept paper and rags or other debris that might be offensively visible in the harbor. None of the sludge or sand or any of the other elements of the sewage are intercepted.

Q. What is the estimated life of the sewers that are now in operation?

A. The North sewer was projected to be competent until 1930, the South side sewer until 1940.

Q. Can you state the maximum combined discharge capacity of these two sewers?

A. The discharge capacity of the South is about four hundred million, on the North about two hundred million.

Q. The North about two and the South about four hundred million?

A. Yes, sir.

3436 Q. As to the outfall itself at the point of discharge into the waters of the bay, is there any difference between the two outlets?

A. There is not except that one is in deep water and the other is at low tide; they are both turned up directly into the bay.

Q. Is there any difference as to the discharge from one outlet or more in either of these systems, do they both discharge from one outlet, in other words?

A. Practically all the time.

Q. What is the depth of discharge at the South outlet?

A. Thirty feet below low water, about forty feet at high tide.

Q. Take the discharge at the South outfall, have you ever visited that outfall?

A. I was there while it was in course of construction and have visited it regularly since, until last March, about once a month.

Q. What has been your observation as to the visibility of the discharge at that outfall?

A. At times it is not visible, it is slightly visible at other times, at low water or slack water.

Q. With respect to odor from the outfall, did you observe odor at that point?

A. There is a very slight odor at times if you get very close to the surface of the sea, it would be practicably unobservable by anyone sailing about, or moving about, the harbor.

Q. How long have these outfalls been in actual operation?

A. The North outlet was put in operation in '95, early in '95, and the other about eight years ago, in 1904.

Q. What is the grade of the Metropolitan sewerage system in Massachusetts, the average grade; does it differ, in the first place, at different points?

3437 A. In the larger sizes it is about one in thirty-five hundred and in the smaller sizes, three or four feet in diameter, it is one in a thousand, something of that kind.

Q. In your opinion what is the average age of the sewage as discharged from the North outlet?

A. I should say it was fifteen hours.

Q. And the South outlet?

A. It is not far from the same age.

Q. Is this sewage septic?

A. I should not call it so, no sir.

Q. Is there any difference in the result, so far as the septic quality of the sewage is concerned whether the sewage is continuously in motion or whether it lies quiet.

A. It septicises more rapidly when it is not in motion I think.

Q. Since you have been associated with the Passaic Valley Sewerage Commissioners have you made an examination of the plans and specifications for the construction of the proposed sewer?

A. I have, I have been over them carefully.

Q. And have familiarized yourself with them?

A. With the details of them, yes.

Q. Do you know what the grades of the different sections are?

A. At the lower end there is a grade of about one in two thousand.

Q. When you speak of the lower end, do you mean from the Pumping Station out to the outfall?

A. No, from the Pumping Station this way.

Q. You are not speaking now of the outfall?

A. No sir.

Q. Do you, as a matter of technical language, call that a sewer or do you call that by some other name?

A. We call that the main intercepting sewer on this side

3438 and below the station, the outfall.

Q. Then when you say the grade is one in three thousand you refer to what part?

A. To the sewer through Newark.

Q. From the Pumping Station or below?

A. From the Pumping Station this side.

Q. Up to what point?

A. I think the grade change is about the Second River, about the upper end of the sewer, it comes a little quicker.

Q. Have you made any attempt to determine what will be the probable age of the sewage when discharged at Robbins Reef, the average age?

A. I should say it would be from twelve to fifteen hours, about the same as the Boston Metropolitan sewage.

Q. In your opinion is that or is not that septic sewage?

A. I should call it septic sewage.

Q. Are you familiar with the stipulation between the United States, the State of New Jersey and the Passaic Valley Sewerage Commissioners which is contained in complainant's exhibit No. 135?

A. Yes, sir, I have seen it, I have been over a copy of it. I never saw this paper before.

Q. Look at this paper and see if that is the document you are familiar with?

A. I should say this is the same, that what I have seen was a copy of this.

Q. Directing your thought to the plans and specifications for the Pumping Station, do they or do they not embody the requirements of that stipulation?

A. They do.

Q. In your opinion, will or will not the effluent produced from the works as specified produce the results which are guaranteed in the stipulation which you have before you?

A. I think they will, yes sir.

3439 Q. Have you made a determination in any way of the point of the proposed discharge of this system with reference to the State lines of New York and New Jersey.

A. It is within New Jersey waters but near the State line of New York.

Q. How far from the State line of New York?

A. I never took occasion to measure it on the plan, I should say it was within a half a mile.

Q. As compared with the effluent or the discharge rather into the Boston Harbor from the Massachusetts Metropolitan Sewerage District, what in your opinion is the character of the effluent which will be produced from these works?

A. I think this effluent will be very much more clarified as compared with anything that we handle in Massachusetts.

Q. Why?

A. The grease is practically taken out of it in the septic tanks, and most of the sludge, the sand is intercepted beyond the Pumping Station and practically all the sludge and grease would not be in it that we had in the Massachusetts works.

Q. Will the deeper discharge point have any effect in your opinion?

A. It is ten feet deeper and that will have a considerable effect in taking out, I think, the color and odor.

Q. In your opinion, from your experience with the Metropolitan Sewerage District of Boston, do you or do you not think that the discharge at Robbins Reef will be a safe one?

A. I do, entirely so.

Q. How long do you think it will be a safe one?

A. Say until in the neighborhood of 1940, thirty years.

Q. Are there other devices that you know of which can be introduced into this purifying system which will effect a still greater clarification or purification?

3440 A. Additional tanks might be employed taking out possibly some more of the sludge or some special grease appliances for taking out any grease that might be left after passing the station and sewage from manufactuories up and down the line might be modified or regulated before it was introduced into the sewer.

Q. What is the character of the discharge in the Massachusetts Metropolitan District in reference to manufacture's waste, do you have it there?

A. Yes, sir, a great deal of it; it is very similar to this section here, there is a large number of large manufacturies of all kinds there, soap works, tanners, bleacheries, dye houses &c.

Q. Do you know whether or not there are acids discharged into the sewers?

A. Some of the sewerage is strongly acid.

Q. Are there any salughter houses?

A. Yes, sir.

Q. Any silk mills?

A. There are silk mills within my knowledge, and woolen mills.

Q. Tanneries?

A. Tanneries, a great number, yes sir.

Q. Are you familiar with the district that is to be served by this sewer here?

A. I have been over it since last March many times.

Q. Have you made any observations upon the manufacturing industries in this district?

A. We have been into most of the manufactories along the line.

Q. Have you or have you not a corresponding knowledge of the manufacturing industries in the Metropolitan District of Massachusetts?

A. Yes, I should say they are not quite as many as here, but they are in this class, there are a great many of them.

3441 Cross-examination by Dr. O'Sullivan:

Q. I did not quite catch where you pursued your technical studies?

A. Brown University, Providence, R. I.

Q. Did you graduate there?

A. I did.

Q. With what degree?

A. B. P.

Q. What is that degree?

A. That is a technical course connected with the University course.

Q. What does B. P. stand for?

A. Bachelor of Philosophy.

Q. Did you ever graduate as an engineer?

A. No sir.

Q. Did you ever graduate as a chemist?

A. No sir.

Q. Did you ever graduate as a bacteriologist?

A. No sir.

Q. In 1895 you mentioned some connection you had with the Metropolitan sewerage works in Boston; was Mr. Carson your Chief during that time?

A. Prior to that date he was.

Q. Prior to 1895?

A. Yes, sir, he resigned and became engineer of a subway project they had at that date, and I succeeded him in the control of the works.

Q. Didn't you resign first, during your connection with Mr. Carson and with the Metropolitan Sewerage Works in Boston?

A. I did for a short time, part of a year, and was employed by the State Board of Health on their water project.

Q. Was that resignation due to any misunderstanding with Mr. Carson.

3442 A. I do not think it was; I do not know that it was.

Q. Do you recall the occasion of your resigning?

A. Yes sir.

Q. Where did you have any experience outside of the sewage and sewerage systems that discharged into Boston Harbor?

A. In what way do you mean?

Q. As an engineer?

A. I advised with the several commissioners who projected this project, I think I was there six or seven times; I think it was with the first commission who recommended the disposal at this point.

Q. And the scheme then was to discharge it crude was it not?

A. Yes sir.

Q. When did you first begin to practice as a civil engineer?

A. Immediately after leaving school I was employed by the City of Providence.

Q. Although you had not taken the technical course of Civil Engineer?

A. No sir.

Q. Have you been connected with any sewerage system or sewage disposal system other than that discharged into the Boston Harbor?

A. I was connected with this in its early history a number of times.

Q. You were called in, to consult with?

A. I was with the original commission who projected this, I was a member of that original commission, the commission consisted of Mr. Herring, Mr. Croes and myself.

Q. Did you come on from Boston then for that purpose?

A. I was here covering a period of four or five months, I was here once a week or some such matter.

3443 Q. What particular feature of the investigation or collection of data upon which that commission acted were you engaged in?

A. I suggested the method of passing under Newark Bay and thus reaching the harbor.

Q. Why?

A. I don't know why; they asked me to and I did.

Q. In other words you did what they suggested?

A. No, I think I suggested the method.

Q. Why did you want it discharged into New York Bay rather than into Newark Bay?

A. In my judgment it was the finest volume of water for discharge for this and other territory in this vicinity.

Q. What harm did you think it would do to Newark Bay?

A. Newark Bay was of much smaller tidal volume and it was much more shallow; the tidal volume and the velocity were much less.

Q. Had any borings been made at that time of Newark Bay to determine the feasibility of carrying it under Newark Bay and into New York Bay?

A. I do not recall whether there were borings at that time or not.

Q. Have any other borings been made at any time during your connection with the original commission?

A. There was a study by a man named Owen who was called on to advise about it, and instead of accepting his project we recommended it be taken over to this larger tidal volume of New York Bay.

Q. Was he a geologist?

A. I think he was a county engineer, James Owen.

Q. Are you aware of any borings that have been made by geologists to determine the feasibility of making a tunnel under these two bodies of water that would transport this sewage?

A. There were a variety of deep borings made by the present Passaic Valley Sewage Commissioners, they go down much 3444 below any depth they have projected to drive their work.

Q. Who made the borings, do you know?

A. I could not say what contractor; the cores are filed in the archives of the commission.

Q. Were they wash borings or otherwise?

A. They were wash borings down to the rock and the rock was drilled for a long distance, I should say perhaps one hundred feet.

Q. What rock did they strike?

A. They struck largely limestone.

Q. At what depth?

A. I think about forty feet below the bed of the bay.

Q. Are you quite sure about that Mr. Brown?

A. No I am not, I told you, I think. It is a matter of record on the plans of the Board, but they struck, below the sludge of the bed of the bay, something like a hard pan, clay and rock, and below that they struck sand stone and they took a great number of borings in it, enough to develope in my judgment the character of the rock very fully.

Q. How deep down did they go in their borings?

A. I say I think about 100 feet into the rock.

Q. Will you state positively that they did not go over 160 feet?

A. I will not; I told you I thought so.

Mr. Riker: It is utterly immaterial whether it was — not and I object to this line of questions as not cross examination and as immaterial and irrelevant.

The Commissioner: Note the objection of defendants' counsel.

Q. Are you engineer now employed by Passaic Valley Sewerage Commissioners?

A. I am.

Q. And you have charge of this construction work?

A. Yes sir.

3445 Q. And part of that construction work in this tunnel that is presumed to carry the effluent from the disposal works on the Newark Meadows out to Robbins Reef or a point near to it?

A. It may be part of the project, yes sir.

Q. It is important for me to know; if it is not part of the project I will stop right away, that ends my interest in the suit. If Mr. Riker will assure that is not part of the project, I am ready to stop now.

Mr. Riker: Why argue; go on and ask your questions and Mr. Brown will answer them if he can and I will make such objections as I see fit. That is about all there is to that; I am not trying your case nor do I desire to.

Q. Have you considered the feasibility of constructing such a tunnel at all?

A. I have, yes, sir.

Q. Would it be necessary, in considering the feasibility, for you to know the character of the material through which the tunnel would be bored?

Mr. Riker: Objected to on the ground that it is not cross examination and that it is not material or relevant to the inquiry.

The Commissioner: Note the objection of counsel for the defendant.

Dr. O'Sullivan: Complainant's counsel presses the question as being a material one because if it were an unfit material the sewage effluent would escape before coming to the discharge pipes that are so elaborately described in the plans of the Passaic Valley Sewerage Commissioners.

Mr. Riker: I do not see how that concerns the complainant; whether it did or not it would be within the territory of the
3446 State of New Jersey.

A. It would be desirable to know it, yes sir.

Q. What efforts have you made to acquire knowledge on that subject?

Mr. Riker: Objected to as not cross examination and not relevant or material.

The Commissioner: Note the objection of Counsel for the defendants.

A. I have made no further effort except to examine the preliminary studies of the Board.

Q. How deep under Newark Bay will the tunnel be?

A. I don't know.

Q. You used the term "septic tank" in answer to a question of Mr. Riker; does the Passaic Valley Sewerage Disposal System contemplate the use of a septic tank in the sewage disposal works?

Mr. Riker: I submit that the words "septic tank" were not used at all and I object on that ground. If I am wrong in my recollection, the record will show.

The Commissioner: Note the objection of the counsel for defendants.

A. I did not intend to refer to a septic tank, the tanks projected are all open tanks, sedimentation tanks.

Q. Do you recall using the term "septic tank"?

A. I do not; it was a mistake if I used it, there is no septic tank projected.

Q. Do you recall using the term "septic sewage"?

A. I think I did say septic sewage, I think Mr. Riker asked me if in my judgment the sewage of the metropolitan system was septic.

Q. You described the multiple outlets through which this effluent is to be discharged; have you any experience or have you 3447 had any experience with multiple outlets?

A. The outlets that I have built have been single outlets.

Q. What study have you given to New York Upper Bay and contemplated sewage discharges into New York Upper Bay and its capacity for digesting or assimilating such sewage?

A. Practically nothing of recent date.

Q. What knowledge have you of the current and movements of water in New York Harbor?

A. Very little.

Q. Have you studied this sewage disposal scheme for disposing of the sewage of the Passaic Valley as it is projected?

A. I went into it very carefully in '97; the project was not materially different at that time.

Q. When was the last report by the Passaic Valley Sewerage Commission on these contemplated works?

A. It was not made by me and I could not tell you, I think it was about 1908.

Q. Has any report, to your knowledge, been made since 1908 by the Passaic Valley Sewerage Commissioners?

A. Not within my knowledge.

Q. Have the plans and specifications been materially changed from those contemplated in the year 1908 by the Passaic Valley Sewerage Commissioners?

A. I do not think they have, no, sir.

Q. Have you seen the plans as designed by Mr. Edlow Harrison and Mr. William Gaven Taylor and dated December 1, 1910?

A. I have, yes, sir.

Q. Will you look at complainant's exhibit #135 and see whether the scheme for securing the effluent described in that stipulation in any way materially differs from the plans designed by Mr. Harrison and Mr. Taylor in 1910?

3448 A. I do not think it does.

Q. When was that stipulation executed, Mr. Brown?

A. October, 1909 is the date on the first page.

Q. Look at the latter part of the instrument.

A. April 14, 1910.

Q. Were the plans completed to procure the stipulated effluent in that exhibit, complainant's exhibit #135, at the time of the execution of the stipulation by the respective agents of the Federal government and the State of New Jersey?

A. I was not here, I could not tell; I believe they were, though.

Q. Were you in the room when I was asking Mr. Phillips about the bi-passes on the intercepting sewers?

A. I think I was, I was sitting over there, I think.

Q. How many bi-passers are there in *this* intercepting sewers before you reach the disposal works?

A. I do not know exactly what you mean by passers; if you mean overflows from existing sewers, there are about fifty.

Q. Is that a new term to you, bi-passers?

A. It is on such a structure as this.

Q. Do you know of that term in any relation when used by civil engineers?

A. A bi-pass is a channel which turns a flow around some existing structure or object of some kind; those you refer to simply turn the sewage from one direction and flush it into a channel flowing in some other direction, that is all.

Q. Is there any provision in the Passaic Valley trunk sewer project for the turning of the sewage into the Passaic River on occasions or into the Newark Bay on occasions?

Mr. Riker: Objected to as immaterial and irrelevant, having nothing to do with the issue and not cross examination.

3449 The Commissioner: Note the objection of counsel for the defendant.

Dr. O'Sullivan: That is for the purpose of showing that it is the intention of the Passaic Valley Trunk sewer project and of the Passaic Valley Sewerage Commissioners to turn this sewage on many occasions into the Passaic River and into the Newark Bay, thereby defeating the very object for which the trunk sewer scheme is designed.

Mr. Riker: The suggestion of counsel for the complainants appears to be absolutely impertinent to the issues because it does not concern the State of New York what happens to the sewerage as far as the discharge into Newark Bay or Passaic River is concerned.

A. I do not think so, no, sir.

Q. Do you know positively whether there are or not?

A. There are not; there are provisions for turning some small part of it. All separate sewage is intercepted without overflowing.

Q. Does the system become a separate one or a combined one in the proposed sewer?

A. It is intended to take all the separate sewage and part of the combined sewage.

Q. How do you determine which of these you will let loose into the Passaic River or Newark Bay?

A. If the sewers have been flooded by storm it has to go into the river, our structure is not large enough to take the whole storm

flow and the sewage from this whole area, we can only take a very small part of it.

Q. Are these bi-passers designed to prevent flooding of the sewage disposal system?

Mr. Riker: Objected to on the ground that the witness 3450 says there are no bi-passers.

The Commissioner: Note the objection of the defendants' counsel.

A. Intended to exclude storm water from the intercepting sewer.

Q. Before reaching these bi-passers are the storm water and sewage and trade wastes combined in the intercepting sewers?

A. Yes, sir, they are in many of them, in some of them they are not.

Q. In those in which they are combined, how do you separate by a bi-passer storm water from trade waste and sewage?

Mr. Riker: Objected to as not cross examination, immaterial and irrelevant.

The Commissioner: Note the objection of defendants' counsel.

A. An aperture is made in the side of the combined sewer, a small passage is led from that to the intercepting sewer and that is closed automatically by a regulating device, so called, a valve that shuts it up.

Q. And now the part of the material which escapes from the intercepting sewer is a combination of sewerage, trade waste and storm water, is it not?

A. It is the ordinary house sewage very largely, diluted with storm water.

Q. And why not the trade wastes?

A. The trade wastes, if in the combined sewer, are diluted in the same way.

Q. What term do you apply to this point of egress for the sewage into the Passaic River and into the Newark Bay if you do not use the term bi-passers?

A. We call them outlots.

3451 Q. How do you define septic sewage?

A. Sewage that gives an odor.

Q. If it had no odor would you determine that it was not septic?

A. Practically we would call it sewage that is not septic, technically I presume any sewage is septic after it begins to be put in the sewer and runs; it has no practical septification, though for a number of hours after it is in the sewer.

Q. Do you recognize such distinction for sewage as fresh, stale and septic?

A. Stale sewage is known to me as sewage of say a day's age; septic sewage, after it begins to be very odorous; fresh sewage up to something like twenty hours—fifteen or twenty hours—in the sewer.

Q. Do you measure it entirely in terms of time?

A. I do myself; there are other methods of measuring; chemists, biologists and others measure it by other means.

Q. Do you recognize that septic sewage may be highly septicized and yet not give off offensive odors?

A. I do, yes, sir.

Q. Have you read any works on septic sewage?

A. I have, yes, sir.

Q. Are you familiar with Mr. Fuller's works?

A. I am, I own a volume, yes, sir.

Q. Let me see if you will agree with his definitions of fresh, stale and septic sewage. I read from page 70 of Mr. Fuller's work on septic disposal: "Sewage at first contains free oxygen and nitrogen in the form of nitrates and nitrites and the proportion of organic matters in suspension is comparatively large. Such a liquid we call fresh sewage." Would you apply that definition to fresh sewage?

3452 A. I would make no objection to it.

Q. I ask you if you would accept it?

Mr. Riker: He has answered it.

Q. Will you give me your definition of fresh sewage?

A. I told you sewage running in the sewer up to twenty hours or more, such a matter as that.

Q. Even though septicization had taken place?

A. Septicization on the terms as you outline it, yes.

Q. Mr. Fuller describes stale sewage as—"sewage when its free oxygen has just become exhausted and its free ammonia increased to the maximum possible by the exhaustion of its oxygen, we designate as stale sewage." Do you accept that definition?

Mr. Riker: Objected on the ground that it has not appeared in evidence that any such definition was given by anybody.

The Commissioner: Note the objection of the counsel for the defendant.

A. I do not object to it, he can make any definition he wants to, that is something I am not responsible for in any way.

Q. Could sewage be stale that had plenty of oxygen?

A. If sewage had a large amount of oxygen I do not think it would be very stale, no, sir.

Q. But with you these distinctions are drawn in terms of time entirely and have no relation to nitrogen, oxygen, free ammonia or any other constituent elements of sewage?

A. No, sir.

Q. Do you know whether there would be more organic matter held in solution by the liquid portions of sewage when the sewage is septic or when the sewage is fresh?

A. I do not, no, sir.

3453 Q. Has any provision been made in the stipulation as shown in complainant's exhibit #135 to eliminate organic matter in solution?

Mr. Riker: Question objected to on the ground that the exhibit speaks for itself.

The Commissioner: Note the objection of defendants' counsel.

A. I do not know about that, I am not prepared to testify.

Q. What organic matters are held in solution?

A. I do not know, I am not a chemist, I am not a chemical expert.

Q. What colloidal matters are held in solution?

A. I do not know, I am not a chemist.

Q. What provision is made in the stipulation to exclude pathogenic germs from the effluent you propose to discharge into New York Bay near Robbins Reef?

Mr. Riker: Objected to on the same ground, that the exhibit speaks for itself.

The Commissioner: Note the objection of the counsel for the defendant.

A. I do not know.

Redirect examination by Mr. Riker:

Q. You have stated that you were concerned in the original project, on the original commission?

A. Yes, sir.

Q. What treatment was the effluent of the sewage to receive under that plan?

A. Rough screening and continuous discharge from one outlet.

Q. Do you think that such a discharge, treated by rough screening, at Robbins Reef, would create a nuisance?

A. I do not, no, sir.

Q. Do you base that opinion on any experience and if so, 3454 where?

A. On the experience I had with the Massachusetts outfalls.

Q. Why have you not taken into consideration the tides and currents in New York Bay as bearing on this question?

A. The tidal volume was so great and the known velocity was so ample that it was not necessary to make a detailed study of the tidal volumes.

Recross-examination by Dr. O'Sullivan:

Q. How much dilution is there now in New York Upper Bay?

A. I do not know.

Q. What portion of the flood on each flood tide consists of water that has already been in the harbor and been diluted heavily?

A. I do not know.

Q. And yet are not these necessary for you to know when you are entertaining the question of solution?

A. I do not think so.

Q. No matter how polluted the water was it was unnecessary for you to know as a basis for determining the question of the effect of the dilution from the Passaic Valley sewage to be discharged into it?

A. I did not say that, I said I did not know what the pollution of New York Bay was.

Q. Does sewage discharged into tidal waters cause greater pollution than the deposit from the bottom of those waters?

A. I do not know what you mean by your question.

Q. (Last question read to witness.)

A. I do not know what that means.

Mr. Riker: Counsel for the defendants objects on the grounds that he does not know what that means.

The Commissioner: Note the objection of defendants' counsel.

3455 Q. Do you make a distinction between sewage and sewage deposits?

A. There is a deposit from sewage, a sludge deposit from sewage, if it loses its velocity it gives it up in any channel it may be running in.

Q. Do you make a distinction between sewage and sludge?

A. Sludge is a product of sewage as I understand it.

Q. Do you make a distinction between the two or do you use them as synonymous?

Mr. Riker: Objected to on the ground that witness has already answered that he does make a distinction.

The Commissioner: Note the objection of counsel for the defendant.

A. Ordinary house sewage carries sludge with it, there is sludge in the sewage.

Q. By what name do you describe the deposits in tidal waters that have been made there by sewage?

A. They are sometimes referred to as mud.

Q. Do you ever use the term sludge?

A. I never have, no, sir.

Q. And by mud you mean the deposit from sewage?

A. I say it is sometimes alluded to as mud.

Q. Do you use that term?

A. No, sir.

Q. What term do you use?

A. I have not used any because we do not have it where I was.

Q. In Boston?

A. Yes, sir.

Q. Have there not been complaints made by some of the federal authorities there and have they not been directed to have their outfall removed from its present position in Boston Harbor?

3456 A. I have not heard of it.

Q. Is it not a fact?

Mr. Riker: How can he answer that when he says he has not heard of it?

Q. I now ask you if this mud, sludge or sewage deposits, by whatever name you describe it, will pollute water to a greater extent than the sewage discharged into those waters?

A. I could not say, sir, I do not know.

Q. Mr. Riker asked you whether you had been in the original

project to run a trunk sewer into New York Upper Bay and discharge this crude sewage and you said you had.

A. I was one of the commission that recommended the discharge in New York Bay off Robbins Reef?

Q. Of crude sewage?

A. Yes, sir.

Q. And you still think that would be a good idea?

A. I do, I think that is the best disposal for this district.

Q. The most economical, too?

A. I do not say that.

Q. Who was the senior member of the commission on which you served and which recommended that project?

A. Rudolph Herring.

Q. Do you know whether or not he has since condemned that scheme and even the present scheme of sewage disposal adopted by the Passaic Valley Sewerage Commissioners?

Mr. Riker: Question objected to on the ground that it is impertinent, is not cross-examination and is not competent, and counsel directs the witness not to answer.

The Commissioner: Note the objection of counsel for the defendants.

A. He never in my presence objected to it, whether he
3457 has or not is unknown to me.

Q. How recently have you seen Mr. Herring?

Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of the counsel for the defendants.

A. I saw him within a year I think.

Q. Have you discussed the Passaic Valley trunk project with him?

A. Not particularly.

Q. Did you discuss the Imhoff tank system with him?

A. I don't think I did, no, sir.

The further taking of testimony in behalf of the defendants was then adjourned until Tuesday, the 31st day of December, 1912, at 10:30 o'clock a. m. at the office of Messrs. Riker and Riker, in the city of Newark, N. J.

3458 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,

VS.

THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Taking of Testimony at the Office of Messrs. Riker & Riker,
Newark, N. J., Tuesday, December 31st, 1912.

Before James D. Maher, Esquire, Commissioner.

Appearances:

Thomas Carmody, Esq., Attorney General of the State of New York; William A. McQuaid, Esq., Deputy Attorney General; Dr. William J. O'Sullivan, Special Counsel, for the People of the State of New York, Complainants.

Edmund Wilson, Esq., Attorney General of the State of New Jersey; Robert H. McCarter, Esq., of Counsel for the State of New Jersey; Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

HENRY MARTYN ROBERT, a witness on behalf of the defendants, being duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. Riker:

Q. Where do you reside, General?

3459 A. In Owego, New York.

Q. Will you state your profession and your professional training and experience?

A. I am an officer in the U. S. Army; I was educated at the Military Academy at West Point, N. Y., in 1855-57. I graduated and entered the corps of engineers in 1857, remaining in that until my retirement as chief of the corps in 1901. I served as instructor at West Point in mathematics and natural philosophy and afterwards as a member of the faculty, at the head of the department of practical military engineering, from '65 to '67. During the Civil War I served as an engineer and officer until my health broke down and I was engaged on fortification work, the construction of fortifications. Since that time I have been upon various engineering duties in charge of river and harbor improvements and light house construction and fortification work on the Pacific coast, the Atlantic coast and on the lakes. I also served as engineer commissioner for the District of Columbia, from 1895 to 1901 I was president of the Board of Engineers for fortifications, of the New York Harbor Line Board, the Philadelphia Harbor Line Board, and the examination of engineer officers for promotion and of the Board of visitors of the engineering School of Application for the training of engineer officers.

Q. What opportunity have you had for the observation of different harbors in the United States?

A. I have been stationed at various harbors during most of this time, such as New York, Philadelphia, San Francisco, Portland, Oregon and so forth and have had to make the study of various harbors that I have either been in charge of or a member of the Board designing such harbors such as Galveston, Pensacola, the mouth of the Mississippi, the Harbor of Los Angeles and so forth.

Q. What opportunities have you had for observing the 3460 conditions in New York Harbor, General?

A. I was stationed in New York City, with my office in the Army Building, from 1893 until 1901; during that time in the summer I resided for three summers, and also for two winters, at Fort Wadsworth, just below the Narrows, or at the Narrows and had opportunities to see the condition of the Harbor such as anyone would, passing constantly over the ferries and also from attempting to use a bathing house we had on the place.

Q. Did you have any official connection with the Harbor Board Line outside of that of member?

A. I was President of the New York Line Harbor Board from 1895 to 1901.

Q. Did the matter of the plans of the Passaic Valley Sewerage Commissioners come before you in your official capacity at any time?

A. Yes, in 1897.

Q. Do you remember where the proposed outfall or outlet of the sewer was at that time?

A. Merely that it was in Newark Bay.

Q. Will you state your own observation of the character of the waters in New York Harbor and your knowledge of the quantity of the Harbor water and the periods required for the displacement of the waters by fresh sea water and fresh land water?

A. What was the first part of that question?

Q. Your particular observation of the character of the waters in New York Harbor?

A. I was struck with one thing, that the beach just below Fort Wadsworth where I resided was very much interfered with by the deposit on it of dead animals and so forth, so that I, after probably two attempts, stopped using a fine bathing house we had 3461 there. But I understood that this material did not come right from the sewage, direct, but was blown in there, I was told, from the outside, from the deposits made by the New York authorities.

Dr. O'Sullivan: I object to the witness stating mere hearsay, what he heard.

The Commissioner: Note the objection of counsel for the complainants.

Witness: This was a nuisance, there is no question but that was a nuisance. As to what caused it I do not know, but I should say that it was, as my recollection is, always connected with the wind

that blew from the sea, whenever these disturbances occurred. At other times the bathing place was all right. That was all the opportunity I ever had for observing these things; I never made any chemical test nor any examination of the waters in that way.

Q. When was it you observed these deposits on the beach?

A. In '93, '4 and '5, the summers of '93, '4 and '5.

Q. Have you any knowledge of the quantity of water in the upper Bay and the period required for its displacement by fresh sea water?

A. There is roughly about fourteen thousand million cubic feet, as I understand; in the upper bay, and the amount going through on a tide is pretty nearly as great as that, as far as I can see, that the amount going out at the Narrows is pretty nearly as great as the contents of the bay. But it does not go out to sea, but is returned, a great part of it, into the bay, with that oscillation, and the rate of its movement is such that it would take several days for it to get out, so as not to return again.

Q. Are you familiar with the stipulation between the United States, the State of New Jersey and the Passaic Valley Sewerage Commissioners?

3462 A. I have read it over somewhat carefully sir.

Q. What is your opinion of the effect of the discharge of an effluent produced as described in the stipulation in question upon the waters of Upper New York Bay?

A. Of course it will add to the pollution of the bay. My opinion is that treated as described it would not injure it seriously provided that from other sources it was not polluted too much. That is, you take the present pollution as an example and put into it what is to come from this sewage project and I would not regard it as making that so as to create a nuisance.

Q. Have you attempted to determine what the probable effect of this discharge as described in the stipulation would be over a period of years when the population of the district shall have increased?

A. Yes sir. I would perhaps put in this way what has occurred to me:—Suppose there was a population of ten million people using the ordinary average of one hundred gallons of sewage per person, we would have one thousand million gallons of sewage per day to take care of. The flow of the Narrows would be approximately during the day, the two tides, twenty-eight thousand million cubic feet, which would amount to over two hundred thousand million gallons, or, in other words, the amount of water going out is two hundred times as much as the sewage. If it all went out to the sea and none was returned the sewage would be very much diluted. Allowing that it took six days to get rid of the whole of that sewage, in other words allowing it was six times as strong as that, there would be about thirty times as much water as sewage; in other words the sewage would be approximately three per cent the amount of water that dilutes it. The sewage itself, taken as the strength that is generally considered as the average of American sewage,

3463 that is, one part organic matter to a thousand of water, would be diluted so that there would be one part organic matter to about thirty-three thousand of water. It does not seem to me that such sewage would prove a nuisance. Furthermore, I think that sewage is taken a great deal stronger than the Passaic Valley sewage would be under the agreement with the United States Government. I notice that the English standard sewage is put down as less than one-third the strength of American and I think that the agreement with the United States Government requires the Passaic Valley Sewerage Commissioners to take such steps as would reduce this sewage away below the ordinary American standard and more nearly to the English.

Q. Now General, when you were testifying as to the time when there might be ten million inhabitants using this bay to discharge sewage into, were you considering the sewage as the standard American sewage?

A. Yes, sir.

Q. Even at that, is it your opinion that with a population of ten million the waters of the bay would become a nuisance from the discharge of sewage from that number of inhabitants?

A. Provided that sewage is not in large particles and so forth, provided it goes through small sieves and so forth and is reduced in that way and is disposed of like your agreement requires, where the current is strong and deep, I would not think so, sir; that is, in the bay, we are talking about New York Bay.

Cross-examination by Dr. O'Sullivan:

Q. Did you ever make any chemical examination of the waters of New York upper bay?

A. No sir.

Q. Did you ever make any bacteriological examination of the waters of Upper New York Bay?

3464 A. No sir.

Q. Have you ever been in charge of a sewage disposal system?

A. I have had nothing to do with sewage, I am not a sewage expert.

Q. Are you familiar with the Passaic Valley Water Shed?

A. I would say no sir, nothing but just the general knowledge that everybody has.

Q. Have you any knowledge, General, of the amount of deposit of sewage matters in the waters of the upper bay?

A. You mean New York Upper Bay?

Q. New York Upper Bay.

A. I understand there is a great deal, sir; I only know it from reading, that there is a great deal, and especially near the shores.

Q. Do you regard these sewage deposits, General, as a more prolific source of pollution than the fresh sewage discharged into these tidal waters?

A. My opinion would be worth nothing on that, sir, I really don't know sir.

Q. What index, General, do you take to measure the capacity of waters to receive sewage discharges?

A. As I stated sir, I am not an expert at all on that matter and come to it purely from the position of a harbor engineer having had to design a good many of the harbors of the United States and having to look out for them with respect to the interference with channels more particularly and am not an authority on these matters to which you refer; my opinion would really be worthless upon them if I had any at all.

Q. Why do you take one hundred gallons of sewage per capita as a fair average for the Passaic Valley district?

A. I take that, not for the Passaic Valley District alone, I take it for the whole of New York and the vicinity and I took 3465 it simply because I found in reading the matter up that was usually assumed to be about what was used except in the manufacturing districts where they use rather more. But where they did not use it I found that the English authorities—at least, by looking at the Encyclopedia Britannica, I found they did not allow as much as that in England.

Q. Will you name some city in the United States where the average sewage per capita is less than a hundred and fifty gallons?

A. I have never looked into that question; I found that the average sewage of England was taken at thirty gallons of water per inhabitant.

Q. Do you realize, General, that the English do not bathe and use as much water as we do in bathing and for other purposes?

A. I know they do not use as much water, as I have had something to do with the water-works, a little, occasionally; they do not use anything like as much water as we do, I did not know the other about bathing, I rather thought they were a little ahead of us on that.

Q. You were talking about the tidal prism of New York Upper Bay; will you state please what means you adopted to measure the volume of the tidal prism?

A. I did not measure it, I took simply the coast survey and the other estimates, and today I happened to see an estimate of the Metropolitan Board, and they all practically agree as to the amount of water of the ebb-tide passing through the Narrows; that is what I have taken as the figure.

Q. What percentage of the water that leaves the upper bay on the ebb returns on the flood into the upper bay and into the East River and the Hudson River?

A. I think somewhere about ninety percent, approximately.

Q. Your examination- of the condition of the waters of 3466 the upper bay, I understand, were confined to such observations as you made from ferries?

A. Oh yes; I made no observations of that sir, I had no duty that made it necessary for me to observe that class of thing.

Q. And these deposits that you found near the bath house, came from the outer water you say, from the ocean?

A. That is what was said, and the nature of the wind and so

forth led me to think so, and I also could not conceive of New York allowing such things to go through the sewers.

Q. Do you realize, General, that all the sewage from Manhattan Island is very fresh sewage?

A. Yes sir.

Q. Within a half an hour old?

A. Yes sir.

Q. And you realize that such sewage is disintegrated by biological action?

A. Yes sir.

Q. As to the character of the Passaic Valley sewage, the sewage that is now being discharged into the Passaic River, have you any knowledge of that?

A. No sir, not at present.

Q. You do know, as a general proposition, that it is very rich in organic matters due to the character of some of the trade waste?

A. Yes.

Q. And that these organic matters are in solution?

A. Yes.

Q. Have you read the scheme projected for the procuring of the effluent which is guaranteed in the stipulation as set forth in complainant's exhibit No. 135?

A. I have read what purports to be a printed copy of it.

3467 Q. And it consists in coarse screening and sedimentation, am I right, sir.

A. Yes sir; there are two screenings as I recollect, the coarse screens, and then, what are termed here fine screens, but they are four-tenths of an inch.

Q. Which is rather a coarse screen, would you say?

A. It could be finer, sir—they might be finer to advantage and the United States Government could require that to be done provided it was found that was not fine enough.

Q. How old would you think that sewage would be by the time it reached the outfall, General? The sewage contemplated to be discharged by the Passaic Valley Trunk Sewer?

A. This would be purely a guess, sir, I have not looked into that matter of how long it would take; I have not examined the details sufficiently, really, to be able to tell how long it would take from the upper—I suppose you mean from the upper point, like Passaic?

Q. Yes.

A. Because it would vary as you go along. I really would not like to express an opinion, it would be a pure guess unless I stopped to work out something on it, sir.

Q. Do you regard the Trunk Sewer as approximately twenty-six miles long?

A. I do not understand that question, sir.

Q. Do you know whether or not the trunk sewer contemplated to be built by the Passaic Valley Sewerage Commissioners is approximately twenty-six miles long?

A. I understand it to be about that length.

Q. And that the grade is rather light?

A. Not very great, sir, I do not recollect what it is.

Q. And that sewage transported from Paterson would take fifteen to eighteen hours to reach the sewage disposal works contemplated to be built on the Newark Meadows?

3468 A. I have not looked into that, sir.

Q. You do realize that much of that sewage would be practically matter in solution when it reached the detention tank and sewage works?

A. I should suppose so.

Q. Is there any provision in the stipulation and in the scheme for purifying the sewage that would eliminate those organic matters which would be held in solution?

A. No sir.

Q. Do you know, General, that there is colloidal matter incident to the trade wastes of the Passaic Valley manufacturing plants?

A. No sir, I do not know anything in regard to that, I have not looked into the question of the manufacturing plants.

Q. Is there any provision in the stipulation as set forth in complainant's exhibit No. 135 that will eliminate these colloidal matters from the effluent contemplated to be discharged into the New York Upper Bay?

A. There is not, sir, as far as I know.

Q. Is there any provision in the purification scheme for the elimination of pathogenic germs from the effluent contemplated to be discharged into New York Upper Bay?

A. No sir.

Q. As to Putrescibility, will the solid organic matter or the organic matter in solution be most putrescible?

A. The solid matter or that in solution?

A. Yes.

A. I don't know sir: I might have an opinion, but it would not be worth anything, I do not know.

Q. Will septic sewage deprive tidal waters into which it is discharged of their oxygen contents more readily than fresh sewage.

A. I don't know that, sir.

Q. Your calculation of the amount of dilution that would probably take place when the population amount to ten million is predicated entirely on the sewage per capita not exceeding one hundred gallons?

A. That calculation is based on that, sir.

Q. And that calculation would not hold if it was shown that the sewage per capita was greater than one hundred and twenty-five gallons per capita?

A. You would simply, in that case, have to take eighty per cent of it.

Q. And in case it was shown to be two hundred and eighteen gallons per capita, in the same ratio you would diminish the percentage of dilution?

A. Yes sir.

Q. Do you know of any reason why sewage effluent such as

stipulated for in complainant's exhibit No. 135 should not be discharged into Newark Bay?

A. Yes.

Q. Why, General?

A. The amount of mineral matter in suspension in that sewage, supposing it to be at the average I spoke of, one part of mineral matter to one thousand of water, would be so much in the course of the year to interfere very greatly with the navigable channels?

Q. So that, from the effluent as stipulated in complainant's exhibit No. 135 you would expect sufficient matter to be deposited so that it would to some extent interfere with navigation?

A. In Newark Bay, quite seriously.

Q. Have you made any approximate estimate of what the amount of deposit would be likely to be?

A. The project provides for an approximate discharge of about forty-five million cubic feet of sewage per day which estimated simply at the weight of water, would amount to about twenty-eight million pounds, which would amount at least to twelve hundred cubic yards of solid deposit per day, or, during the year, to over four hundred thousand yards cubic yards of deposit. The entrance to Newark Bay is quite shallow and the deposit of nearly half a million cubic yards each year of solid matter there would mean a great deal of injury to the channel.

Q. The deposit which you have just testified to, as, in the course of probability being likely to be deposited, relates to the deposit that you expect from the sewage effluent stipulated for in Complainants' Exhibit No. 135?

A. It would be the maximum; I would not expect so much as that, sir.

Q. But approximately that much.

A. I would feel that it might be from half that amount to that amount.

Q. From the sewage effluent stipulated for in Complainants' Exhibit No. 135?

A. Yes, sir.

Q. You have stated, General, what deposit you would expect from the sewage effluent guaranteed or stipulated for in Complainants' Exhibit No. 135, and as I understand it relates to the mineral matter?

A. Yes, sir.

Q. What would you estimate the deposit to be from the finer organic particles in that stipulated effluent?

A. I could not estimate on that.

Q. Approximately?

A. I really have no idea of how much that would be. Assuming as I do that the statements of the standard sewage in the ordinary authorities are correct, and that this sewage is only in that condition—of the standard—there would be an equal amount of organic matter,—an amount of organic matter equal to the other; but I presume that that would be very soon dissolved or devoured by the life, the fishes and so forth, and that there would not be so much of that deposit—there would not be much of that deposit near by.

Q. In order to get some approximate idea of the amount of deposits that you would expect from the organic particles in the effluent guaranteed or stipulated for in Complainants' Exhibit No. 135, would you state as to whether it might be one-half as much as the other or one-quarter as much?

A. I would not expect it to be either, sir.

Q. Even less than a quarter?

A. Oh, yes, sir.

Q. How much less, can you give me an idea General?

A. No, sir, I would simply say, never having studied that proposition, that I really have no opinion upon it excepting the general idea that it would not be a very large deposit there.

Q. As compared with the mineral deposit?

A. Yes, sir.

Q. Did you make any estimate of the colloidal matters that would be deposited when meeting sea water that would act as a precipitant upon the sewage in the effluent guaranteed in Complainants' Exhibit #135?

A. No, sir.

Q. Would you give an approximate idea of how much you would expect the deposit to be in proportion to the amount of unorganic matter?

A. I do not know, sir, at all, I really have no opinion upon the subject, as it is a matter which I have never examined.

Q. But you would expect deposits of both of these matters to some extent, both the finer organic particles in suspension and the colloidal matters that would be precipitated?

A. I understand these questions as relating entirely to Newark Bay?

Q. I am speaking about the sewage effluent guaranteed in 3472 the stipulation.

A. At Robbins Reef, under those circumstances?

Q. Yes.

A. Oh, I would like in that case—I thought we were discussing Newark Bay, and the cases are so different; the velocity of the current, the depth and so forth are so different that I am not sure whether I answered those questions correctly because I assumed we were still discussing the Newark Bay proposition.

Q. Let me put this question to you, General. Would that sewage, effluent differ if it were discharged in New York Bay from what it would be in Newark Bay?

A. No, sir.

Q. So that your answers would apply, as they did apply, to the sewage effluent itself, did they not?

A. Not necessarily, sir. I want to know exactly what the questions were.

The point is this, whether it is deposited, or not, in a shallow, flat place, without any current, scarcely, is a very different proposition from whether it will be deposited in water seventy-five feet deep and placed in a current of some rapidity and forty feet below the surface. The tendency is to raise up, and if it is in that condition the question of whether there is a deposit or not is very different *it if is to fall*

thirty feet before it is deposited, as an illustration, or whether it is only six inches.

Q. But the essential feature, that there would be deposit no matter where they were deposited, is correct, is it not?

A. As that question is put, I suppose it is, only it may be this, that it might be one-tenth of one per cent in one case and fifty per cent in the other. There is such a difference that the answer might be misunderstood.

Q. The only difference, as I understand, that is in your mind relative to the deposits in these respective locations at Robbins Reef and at Newark Bay depends on the velocity of the current and the shallowness of the body of water in one case and the depth of the body of water in the other case; these are the qualifying factors?

A. Those are the main—yes, sir.

Q. But the deposits, no matter where they are made, come from the sewage effluent and are about the same in amount; is that correct?

A. Oh, no, sir, no, sir, for instance—yes, but as a part of it, in the Atlantic Ocean where the discharge occurs this deposit is where it does no harm and in the other case it is deposited where it does injury. I was answering the questions as to where it was very shallow, that it will be deposited very quickly and do a great deal of harm. There is a difference, for instance, whether it is deposited in one hour or in a week or three weeks.

Q. I am not concerned so much with the injury from the deposit as with the fact of the deposit, that fact remains the same for both the locations, does it not, apart from the injury in one location?

A. I hardly think so, Doctor. Let me illustrate: Organic matter that can be deposited in half an hour will be deposited there but if it is going to remain in suspension for a week or a month it would be destroyed before that time comes and there is nothing to deposit, so I do not think that I could say that I agree to that.

Q. You are speaking now of the organic matters that would be deposited?

A. Yes, sir.

Q. That would not apply to the inorganic matter?

A. No, sir.

Q. Such as dyes and matters of that kind, particles of inorganic grit and matters of that kind?

3474 A. Yes, sir, absolutely insoluble matter—if it was insoluble matter. But even that may remain in suspension so long that it is carried out to sea before it falls, for all I know; if its specific gravity was small I could see how it could be carried out to sea before it was ever deposited.

Q. Then if I understand you right, General, the visible suspended particles would remain in suspension longer when discharged at Robbins Reef than they would in Newark Bay. Is that correct?

Mr. Riker: He has not said so, Doctor, he has not said anything about visible suspended particles so far. I object to the question on that ground.

The Commissioner: Note the objection of the counsel for the defendants.

Mr. Riker: If you mean to say assuming there are visible suspended particles that would be one thing, but he has not said there would be.

A. Of course they would because in one case—this is on the assumption that they deposited on the bottom eventually—they may have six inches or one foot to fall and in the other case they may have seventy feet—seventy-five feet I believe in the depth at that point—to fall, and of course they would remain in suspension longer at Robbins Reef.

Q. Your answer now relates to the sewage effluent stipulated for in complainant's exhibit No. 135.

A. Yes, sir.

Q. General, I do not know whether I understand you aright or not, I understood you to say that the English sewage was from one-third to one-half the strength of American sewage and I ask you if you did not mean it the other way, the reference to that?

A. The statement I make is quoted from the last edition, published last year, of the Encyclopedia Britannica on sewage 3475 and which statement I copied; it states that a million gallons of standard sewage—English sewage—contains two ton of suspended matter, one of organic and one of unorganic; I calculated that out and I can let you see the calculations, and I found that it meant one pound of suspended matter, half mineral and half the other, to about 1,860 pounds of water; that means, half a pound of inorganic matter to 1,860 of the other; as I have stated, I am not a sewage expert sir and I am answering at a disadvantage and am giving simply what I have been told—what I have read.

Redirect examination by Mr. Riker:

Q. You were asked in regard to visible suspended particles in the effluent provided for in this stipulation between the U. S. Government, the State of New Jersey and the Passaic Valley Sewerage Commission; I draw your attention to the fact that this stipulation provides there shall be no visible suspended particles; have you that in mind?

Dr. O'Sullivan: I object to that question. This is clearly a statement of counsel which he asks the witness to verify or contradict and I would rather he would put it in the form of a question instead of a statement.

The Commissioner: Note the objection of counsel for the complainant.

Q. I draw your attention to the fact that in this stipulation there is found this clause: "There will be absence in New York Bay of visible suspended particles coming from the Passaic Valley sewage"; had you that in mind when you testified that you were referring to the effluent from the Passaic Valley sewage?

A. Yes sir.

Q. Do you mean by that that in your judgment there will be visible suspended particles there?

Dr. O'Sullivan: I object, this is cross examination of his own witness.

3476 The Commissioner: Note the objection of the counsel for the complainant.

A. No, sir. My idea is, if there was any, and that I understood was the object of the question, that if there was any suspended matter, if it is a foot below the surface or an inch, or what not, it will stay longer before it is deposited.

Q. Assuming there were visible suspended particles, they would remain longer in the water of New York Bay than in the water of Newark Bay?

Dr. O'Sullivan: I object to that as not a question but it is a statement of counsel.

The Commissioner: Note the objection of the counsel for the complainant.

A. (Question not answered.)

Q. Had you intended to calculate the results of the sedimentation process which is described in this stipulation upon the inorganic matters in the sewage?

A. No, sir, I had not.

Q. Do you know how much of the organic matter will probably be removed by that process?

A. I do not, sir. I am simply assuming that there will be a very large amount, of the larger, heavier things, and that the sewage would not be as strong as the average American sewage; but I think I have based my answers on the American Sewage, supposing it was that strong.

Q. When you testified to the discharge of this particular effluent in Newark Bay, had you in your thought anything except the diluting power of the water in Newark Bay as compared with that of New York Bay?

A. I had also the question of the depth of the Bay; the difference is so very great in the two cases that the deposits will be in the Newark Bay almost instantly and the other will take some time.

3477 Q. And had you in mind anything except the matter as it concerned the control of the channels and the navigation of the Bay?

A. No sir.

Q. Do you know whether the increased standard of sewage per capita from thirty gallons, in England, to from one hundred and fifty to two hundred and fifty at other places does or does not involve an increase in organic matter in that sewage?

A. To answer that question I must state that the thirty gallons of water per person, in giving the standard sewage, is based upon domestic sewage, that part, the thirty gallons per person, and does not cover, as I understand, the question of manufactories and as to

what effect the manufactories would have upon it I have not the data and do not know anything about.

Q. So you do not know, then, do you, whether the largely increased estimate of, say, one hundred and fifty gallons per person does or does not involve an increase in actual organic contents?

A. It would not as far as the people are concerned, the domestic; but I assume that that large amount, that large estimate that has been made here, is based upon the need of the manufacturers, I assume that, because otherwise it would be unnecessary.

Q. Where the increase arises, do you think the organic matter would be increased?

A. It would be diminished, of course, in proportion.

Recross-examination by Dr. O'Sullivan:

Q. Do you regard soap as organic matter?

A. I should say yes, but how much is of the other I don't know, I am not a chemist, olive oil is certainly organic.

Q. General, the sewage effluent as stipulated for in complainant's exhibit 135 would occasion the deposits you have described if deposited in the Newark Bay, would it not?

A. I would have to state that, sir, with a qualification.
3478 If that sewage is of the strength of what is assumed for American sewage, the average strength of American Sewage, which I understand includes manufacturing, and so forth, in the proportion of one to the thousand of organic matter, that would be true. Whether it would or not, would require a sewage expert or a chemist—their opinion upon it; that of an engineer would be worthless on a question of that kind.

The further taking of testimony on the part of the defendants was adjourned to the call of the Commissioner.

3479 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
vs.
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE
COMMISSIONERS, Defendants.

Taking of Testimony at the Office of Messrs. Riker and Riker,
Newark, N. J., Tuesday, February 11, 1913.

Before James D. Maher, Esquire, Commissioner.

Appearances:

Thomas Carmody, Esquire, Attorney General of the State of New York; William A. McQuaid, Esq., Deputy Attorney General; Dr. William J. O'Sullivan, Special Counsel, for the People of the State of New York, Complainants.

Edmund Wilson, Esq., Attorney General of the State of New Jersey; Robert H. McCarter, Esq., Of Counsel for the State of New Jersey; Adrian Riker, Esq., Of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

SAMUEL M. GRAY, a witness produced on behalf of the Defendants, being first duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. Riker:

Q. Where do you live?

A. Providence, Rhode Island.

3480 Q. What is your business or profession?

A. That of a civil and sanitary engineer.

Q. How long have you been engaged in that profession?

A. Since 1862.

Q. What has been your education for that profession, Mr. Gray?

A. At the age of about eighteen I prepared for Harvard. Ill health overtook me; I was obliged to give up attending. The health overtook me; I was obliged to give up attending. I took a trip abroad. On my return I entered directly into engineering work. I was, in the early stages of it, on railroad work and later on on water and sewerage, and for the last thirty-five or more years have been engaged actively in the construction and operation of water plants and sewerage works.

Q. Will you state some of the places and plants with which you have been connected in their operation or construction?

A. From 1884, I was City Engineer of Providence for some fourteen years, during which time I had charge of highways, water, sewers, public buildings, and then for a term of perhaps five years was also a member of the Board of Public Works which had charge of all the different works; in 1884 I was sent abroad by the City of Providence to study the various modes of sewage disposal in Europe,

visiting England, Scotland, Italy, Switzerland, Germany, Holland and some other places. On my return I designed a system for sewage disposal for the City of Providence. I was also appointed as one of the two to design sewerage disposal work for Toronto, Ontario; was appointed by the late President Harrison as one of three to design sewerage works and sewage disposal works for the District of Columbia; was appointed by the late Mayor of Philadelphia—his name goes from me at this moment—as one of three to design works for the purification of the water of the City of Philadelphia; was appointed by the later General Ludlow to visit Havana and design sewerage works and sewage disposal works for that city; designed and built sewerage works for Albuquerque, New Mexico; was 3481 appointed as one of two to remodel the sewerage works of Worcester, Massachusetts, and have been engaged in many like undertakings.

Q. Are you still practicing your profession, Mr. Gary?

A. Yes sir.

Q. Where are you located?

A. I am located in Providence, my office is there.

Q. Are you a chemist by profession?

A. No sir.

Q. A bacteriologist by profession?

A. No sir.

Q. Have you any special acquaintance with either of those branches of science?

A. I would not claim that I have, excepting, of course I have been more or less familiar with them, but I should not claim that I was either.

Q. In the practice of your profession as a sanitary engineer in connection with sewage disposal is it your practice to approach your problems from the point of view of a chemist or bacteriologist?

A. Yes sir, from all sides.

Q. Have you any especial familiarity, or what familiarity have you, with the waters of New York Bay?

A. My knowledge of them is simply what I have seen travelling back and forth over the Bay, and particularly on my way south and west and returning, and occasionally on excursions down the Bay. I have not examined them personally with direct reference to this case.

Q. Do you have any knowledge of the methods of sewage disposal being pursued by the City of New York?

A. I know of no methods of disposal in use there, excepting to discharge it crude into New York Bay, Hudson River, and so forth.

Q. Have you made any study in detail in any way of the 3482 results of that discharge on the waters of the Bay?

A. No sir, except to read the late report of the New York Sewerage Commission appointed to advise as to what may be done in the future.

Q. In your passing up and down from your home city to the various points you have visited, over the waters of New York Bay, have you made any observations of any kind as to the condition of

the waters of New York Bay so far as they are affected by sewage discharged from New York?

A. I have simply made casual observations by sight and by seeing if there were odors, as I have often been somewhat surprised that the vast quantity of sewage emptied in from New York has not produced worse conditions. That is the extent of my observation.

Q. As to the conditions which you have observed casually, do you consider them or do you not consider them particularly objectionable at the present time?

A. I would like to answer that and explain the meaning of my answer.

Q. Yes.

A. I do not, in one sense, not that they are unlike many other places. They are not intolerable. I must say however, that I believe in the principle of disposing of sewage in a way as not to cause a nuisance, and these different ways are very different depending on conditions of each place. But the time is approaching when we should, and I believe it is proper we should, pay just attention to the disposal of our sewage so as not to offend our neighbor or ourselves.

Q. Have you made any special study or observation of the condition in the Passaic Valley?

A. Yes. In 1902 and 1903, I think it was, I was employed by the City of Paterson before the different cities had joined in the trunk sewer project, to see if that city could dispose of its sewage properly without joining in the trunk sewer. I made surveys estimates and a report upon it then. I also at that time examined 3483 the Passaic River up and down, more or less. Do you care to have me say anything further about that?

Q. I would like to ask you what conclusion you reached in connection with the particular problem in the City of Paterson in reference to a separate disposal plant.

A. I reached the conclusion that they could thoroughly dispose of their sewage without joining the trunk sewer, but that it would be very unwise for them to undertake to do it, and advised them to join the trunk sewer movement.

Q. In that study for the City of Paterson did you look into and consider the plan of the Passaic Valley Sewerage Commissioners?

A. Yes sir, as far as it was then developed.

Q. At that time did you find that there was any especial purification scheme involved in the Passaic Valley plan?

A. I forget at this moment whether in 1902 and 1903 the plans were fully developed, although I think they were developed then, but since then I have examined the proposition more carefully.

Q. How lately have you made an examination of the plan of the Passaic Valley Sewerage Commissioners?

A. During the last two years I have given considerable attention to it.

Q. I show you Complainants' exhibit Number 135 in this case being a stipulation in the Supreme Court of the United States in the case in which you are testifying, entered into in behalf of the

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State of New Jersey and the Passaic Valley Sewerage Commissioners with the United States Government, and ask you whether that was part of the plan as you considered it during your last examination of the plan of the Passaic Valley Sewerage Commissioners?

A. This precise paper I have not seen before.

Q. Just look it over and see whether it is in substance the same as the one that you examined?

A. (After an examination of the document.) Yes, I should say that was precisely it.

3484 Q. Taking the plan, as you have examined it, of the Passaic Valley Sewerage Commissioners, including in it for your consideration this stipulation, what, in your judgment from your experience in similar works, will be the result of the discharge of the effluent, produced in the way specified in this stipulation, upon the waters of Upper New York Bay?

A. It seems to me there will be no bad results. I see no difficulties unsurmountable or unreasonable in the requirements of this contract, and see no reason why they cannot be carried out, and if carried out fully, believe that they will result in the conditions which this contract demands should exist.

Q. If the work and processes of partial purification specified in this stipulation are put into effect by the Passaic Valley Sewerage Commissioners, in your opinion will the results that are guaranteed by the State of New Jersey and the Passaic Valley Sewerage Commissioners in this stipulation be attained?

A. I think they will.

Q. Assuming that the purification devices are constructed and the processes are carried out, described, in this stipulation, what in your judgment will be the effect of the effluent discharged from that plant into New York Bay at Robbins Reef, so far as the waters of the Upper Bay are concerned, as compared with the effect of the discharge of the waters of Newark Bay, in its present condition, into Upper New York Bay, through the Kill von Kull?

A. It seems to me that there will be an improvement in this, that the waters of the Bay will not be as badly polluted from sewage coming from the Passaic Valley as they now are.

Q. In giving that answer, what do you assume as to the percentage of the waters of Newark Bay which find their way into the Upper Bay through the Kill von Kull?

A. I have not gone into that.

Q. In considering this problem of the effect of the discharge of the effluent as likely to be produced by these devices and
3485 processes in the water of the Upper Bay, on what do you reach your conclusion; is it on chemical or bacteriological considerations or dilution?

A. It is a consideration such as I am able to give from my contact with the question of chemical action and biological, coupled with my general experience in such cases where sewage is diluted much less than it will be in the Bay, taking the figures of tidal flow and quantity of sewage that have been stated in the evidence given.

Q. If the City of New York should apply to its sewage which is

now discharged crude into New York Bay the same processes which are provided in the stipulation, Exhibit 135, what in your opinion will be the general result upon the waters of the Upper Bay?

A. They certainly will be improved from what they are now; that must inevitably be the result of keeping out a large amount of floating matter; which must be kept out and which now enters, and the keeping back of a great deal of silt, which must find its way into New York Bay, thus causing less pollution to go in than now does.

Q. Would the result of that process, or those processes, if applied by the City of New York, make the waters of the Upper Bay capable of taking care of and disposing of a much larger pollution than there is now discharged into it?

A. I think so.

Q. Are there other devices and processes which might be applied to the Passaic Valley Sewage, to the end of producing an effluent which will comply with the stipulation, in case the methods described in the stipulation should turn out to be insufficient for that purpose?

A. You mean in connection with, or in addition to, the present methods?

Q. In addition to.

3486 A. Yes sir, I think there is no question about that.

Cross-examination by Dr. O'Sullivan:

Q. I understand you did not take an educational degree in Harvard?

A. No sir.

Q. Or any other institution?

A. No sir.

Q. And that you did not graduate as a Civil Engineer?

A. No sir.

Q. And that you did not take any degrees in either chemistry or bacteriology?

A. No sir.

Q. You have made no special study of biology?

A. No sir.

Q. Did I understand you to say that you designed the water works for Philadelphia?

A. No sir; I did not mean to be so understood. I was appointed one of three by the late Mayor Ashbridge to design works for the purification of the waters both of the Schuylkill and the Delaware.

Q. Did you design them or did you simply report on them?

A. We designed the works, the purification works, not all in detail, but in general, and quite sufficient. We recommended the slow sand filtration; we chose the points at which these works should be built; we visited each pumping station, each reservoir, and recommended the use of certain reservoirs which are now storage reservoirs, as covered reservoirs, to retain the water.

Q. Under whom did you first take up any work in engineering?

A. T. Willis Pratt of Boston; he was the chief engineer of the

then Boston, Hartford and Erie; that was my first experience then, as rod man.

3487 Q. When did you first do any work in constructing sewers?

A. I should say in the latter part of the seventies or the first part of the eighties; I do not just remember.

Q. Was it before or after you visited Europe?

A. It was before.

Q. Where did you design those sewers for?

A. I designed them for Willimantic, Connecticut—I cannot be sure that all this was before that time, the dates I cannot recollect—and for Providence, Rhode Island.

Q. That was after 1884, was it not?

A. That was before. Part of it was after; part of it was before.

Q. And that dealt chiefly with the construction of the sewers themselves, did it not?

A. No sir. It did deal with that absolutely, but it also dealt very decidedly with the disposal of sewage of the City of Providence, which was really the main part of the work.

Q. In 1884 were there sewage disposal works designed for Providence, Rhode Island?

A. I was designing them then myself.

Q. Were they ever installed?

A. Yes sir; they have been built and put in operation.

Q. When were they installed?

A. I should say three or four years after I designed them; it might have been more years, but for many years now, they have been in operation.

Q. How did these disposal works contemplate purifying the sewage?

A. By chemical precipitation; by building tanks, admitting the sewage to those tanks and putting in a certain amount of sulphate of alumina or lime and precipitating the solids in suspension and perhaps small parts of the impurities in solution, the sludge settling to the bottom. The effluent was then drawn off, the sludge 3488 passed through presses that pressed out the water and was made into cakes which could be handled; these were first disposed of as a fertilizer, but did not seem to possess value enough for the farmers to pay much for them and that is now discharged down the bay in scows.

Q. Where did you get the idea of chemical precipitation which you applied?

A. In Europe.

Q. In England?

A. Yes sir.

Q. In London?

A. No sir. In many places in Europe, not particularly in London, they were then, I think, not practicing it there.

Q. Are you now in favor of chemical precipitation as a method of sewage disposal?

A. I would advise different methods for different places. That

is perhaps illustrated in this way: For a man with a broken arm we would use splints, but for a man with consumption, we would not put them on. The same variety of treatment must apply to the disposal of sewage.

Q. Do you advocate chemical precipitation now?

A. No sir.

Q. Were those sewage disposal works in Providence, Rhode Island after you had severed your connection with the City authorities?

A. They were built after that, and built according to the plans as designed.

Q. What did you do relative to the Washington sewerage system, the present sewerage system?

A. We designed the main trunk sewers, also the sewer down the Potomac; recommended discharge of the sewage at first in the crude state and making sure and ascertaining that there were areas on which the sewage could be treated in one way or another.

3489 Q. When did you design those sewers for Washington?

A. The date I cannot give you, excepting that it was during the late President Harrison's time.

Q. Do you know whether that sewerage system is still in use in Washington?

A. As far as I know, generally, they undoubtedly made some digressions from it.

Q. Have they in any way modified the system in Washington that you installed?

A. I cannot say for I have not examined it.

Q. Have you read Mr. Phillip's testimony in this case?

A. I do not remember. I have read considerable of the testimony of different witnesses, but I cannot say at this moment whether I read Mr. Phillips' or not.

Q. In the system which you installed in Washington during the regime of President Harrison, were sewage disposal works any part of the system?

A. They were in anticipation, but for immediate disposal, not.

Q. Do you know whether they were ever adopted, any sewage disposal works in connection with the system you installed in Washington?

A. I have no information of any.

Q. As far as you know, there are no sewage disposal works there now?

A. I cannot say that there are, no sir.

Q. What was the grade of these sewers you designed for Washington, the average grade?

A. I do not recollect, sir, at all. Those things, I do not carry them in my mind.

Q. You got a rapid discharge, did you not?

A. Undoubtedly in some of them, and in some of them probably not; I cannot say at all about that.

490 Q. Did you make any calculation in Washington as to the age of the sewage by the time it reached the Potomac?

A. Yes sir, we did, but what that age was I cannot say.

Q. Would you say it was fresh or stale sewage by the time it reached the Potomac, under the system which you installed?

A. That term would have to be qualified a little; I should say it was on an average.

Q. Between fresh and stale?

A. Why, yes. I would not call it fresh and I would not call it stale.

Q. What distinction do you recognize between those terms as applied to sewage—fresh and stale?

A. Sewage which has become septicised may be considered stale; sewage which has been retained long enough to become stale is stale; sewage which reaches the disposal works before it becomes stale is fresh. That is about the only explanation I can give.

Q. We were discussing condition. What effects produce these conditions as between fresh and stale sewage?

A. There are two—there may be more, lengths of time after it is made before it reaches the disposal plant, and the ingredients of the sewage.

Q. Does time enter into the factors which draw the distinction?

A. Oh yes.

Q. Do you, in your own mind, make any distinction between stale and septic sewage?

A. There could be, but that is a very close point, the lines come very near together. Of course, sewage which is septicised has passed through the stages of being foul.

Q. I am asking you how you distinguish, or whether you do distinguish or not, the terms stale and fresh, as applied to sewage, and if so, what the distinction or differentiation consists of?

A. I should say that stale sewage was the first step, the early action, of septicisation.

Q. What would you look for in sewage to determine in your mind whether it was stale or septic or fresh?

A. In fresh sewage I should look for the odors; I should look for signs of floating matter, paper, corks and excrements particularly, and those things. In stale sewage I should look for those more strong odors; putrified sewage to a certain extent.

Q. How long does it take sewage ordinarily to leave the fresh stage and become stale, under the distinctions you have now made?

A. Oh, I could not say, sir. That is one of the infinitesimal questions.

Q. Can you give me an approximation?

A. Oh, I think, in fact, I know, that in a week's time many of the sewages would become stale.

Q. And during that week sewage is usually fresh?

A. Not always, it may become stale earlier than in seven days.

Q. How early, in your experience, has sewage become stale, measuring it in time?

A. My general recollection and opinion of that would be in two or three days, possibly.

Q. And in your experience sewage has retained its freshness as a general proposition, for two or three days?

A. I have seen sewage retain its freshness, that is, not become stale, what I would call stale, for two days.

Q. Have you ever known sewage to become stale in three hours?

A. I don't know that I have.

Q. Will you say it is improbable or impossible?

A. In answer to your first question, whether I recollect
3492 it, I should say no, I do not; and in answer to the second one, I should think, on general terms, general cases, it was improbable.

Q. What would be the earliest time in which you would expect fresh sewage to leave that condition and become stale?

A. As I have said, the term admits of qualification, but taking it as one would naturally understand it, I would not look for its being what I would call stale inside of a day.

Q. What occasions staleness in fresh sewage?

A. The decomposition of the matters of which it is composed.

Q. What occasions these decomposition changes?

A. Chemical action, biological.

Q. Which is it?

A. Both.

Q. Through what biological agencies is sewage rendered stale?

A. The first, the very first, is the action of bacteria on it, which, as it proceeds, purifies it.

Q. How do they operate in purifying the sewage?

A. I am not a bacteriologist; I should not care to enter into that in detail, but generally by the oxidizing, carrying oxygen to it.

Q. As long as there is sufficient oxygen for these bacteria to operate with will sewage become stale, according to the way you distinguish stale from fresh sewage?

A. I cannot say.

Q. Do you distinguish the functional activities of groups of bacteria like aerobic and anaerobic?

A. Yes, the anaerobic acting in the dark, the aerobic operating in light and air.

Q. That is as you understand them?

A. That is as I understand them.

Q. What are the products of bacterial action, as you understand it, when they render fresh sewage stale or septic?

3493 A. I do not understand your question.

Q. (Last question read to witness.)

A. They, as I understand it, break up sewage from its raw state, enabling the aerobic bacteria to operate upon it.

Q. In breaking up the organic matter in sewage and giving rise to the distinctive odors that enable you to call it stale, I ask you what odors they are; what are they due to; what is the product which occasions those odors?

A. The impurities in the sewage.

Q. Is that the best answer you can make?

A. I think it is.

Q. Is hydrogen sulphide ever evolved from these bacterial actions?

A. Yes sir.

Q. Would that gas enable you to distinguish whether or not sewage had septicised?

A. I should expect to find that gas and smell it during the process of septicising.

Q. You say you have been along the Passaic River. I ask you if you have ever smelled that gas as a distinctive odor along the Passaic River?

A. Yes sir.

Q. Did you have any difficulty in locating it?

A. I do not know what you precisely mean. When I was along the brink at certain points I smelled it.

Q. Very distinctive, was it?

A. In some cases it was.

Q. Can you detect by odor the gas methane?

A. No sir.

Q. Can you detect carbon dioxide, that gas?

A. I would not say that I could place it.

Q. Have I now mentioned gases that are the product of septic decomposition?

3494 A. You have some of them. I cannot say that all you have mentioned are not products of it.

Q. Would you describe the present condition of the Passaic River as a condition of septicisation?

A. To a greater or less extent, yes.

Q. Is it but little more today than an elongated septic tank?

A. I should say it was more than that. I should not call it quite as bad as that.

Q. Have you studied the trade wastes that are discharged into the Passaic River at present?

A. Yes.

Q. How many different kinds of factories discharge organic trade wastes into the Passaic River at present?

A. As I have stated, my examination of that river was in 1902 and 1903. Later than that, I cannot find an answer to your question. At that time there were wool washings and dye stuffs, and as I remember it, some tanneries, and there were wastes from other manufacturies into the river.

Q. What organic matter is in the trade wastes from silk factories or mills?

A. I cannot say except that they give it a color oftentimes very different from what it would be if those wastes were not in it.

Q. Do you know what volume the trade wastes of the Paterson silk works, for instance, would equal?

A. I do not.

Q. What other trade wastes are discharged beside those from silk works and tanneries?

A. At that time there were wool washings.

Q. Are those rich in organic matter?

A. Yes.

Q. And highly putrescible?

3495

A. Generally.

Q. What other organic trade wastes beside those we have mentioned can you recall?

A. Applying to this river?

Q. Yes.

A. I have an impression there were some breweries, but will not be sure that they apply to Paterson.

Q. Taking the full length of the river, name some of the factories or mills that discharge organic trade wastes into the Passaic River now?

A. I cannot tell you, sir, as to now.

Q. They discharge directly into the river now?

A. I cannot say as to now. They did at Paterson at that time.

Q. Whatever sewage is discharged now into the river is discharged near the location of the creation of the organic trade wastes?

A. I cannot say as to that; I suppose it is.

Q. And that sewage you have described as being in a condition in the river that has produced something but little better than a septic tank?

A. I do not want to be understood just as your statement puts it. I do not mean to say that it is only a little better. I mean to say that I would not class it as septic sewage or as a septic tank.

Q. I understood you to say that it evolved the gases that are peculiar to septicisation and that you detected them.

A. I did, some of them.

Q. Then would you describe the sewage as septic when it gives off the products of septicisation?

A. Not completely necessary.

Q. What would it lack to make it complete?

A. Time.

3496 Q. What would time accord to it that it lacks?

A. It would break up more thoroughly rendering it more ready for the aerobic bacteria to act upon and oxygenize it.

Q. Would not the aerobic bacteria have to be working to evolve sulphurated hydrogen?

A. Yes sir, I so understand it.

Q. When you have that condition you have a condition of septicisation, have you not?

A. It is being septicised.

Q. Do you think sewage would be improved if carried a long distance in a trunk sewer and detained in disposal works for some time and given opportunities for sedimentation and then discharged through a long tunnel?

A. I understand, and if I am wrong, I would like to be corrected, that you apply that question in connection with the method in which it is proposed to treat it. If so, there are some conditions left out; the screens, the silt chambers, the baffle-boards and other processes.

Q. These all take sometime, do they not?

A. Yes.

Q. I say, adding that time to this condition of the sewage you think it must add to its septification?

A. Why, I think when the sewage was discharged it certainly would be improved, at the time it was discharged, taking into consideration the time that these various processes require.

Q. After septic action once sets in, is it continuous under the conditions that you have described?

A. Yes, generally, if allowed to be continued.

Q. So that that sewage would reach the outfall at Robbins Reef in a septic condition, would it not?

A. More or less so.

Q. Does septic sewage consume oxygen more rapidly than fresh sewage does.

3497 A. I cannot tell you.

Q. Do you know if the processes by which septic sewage consumes oxygen are different from the processes by which fresh sewage consumes oxygen?

A. Not being a bacteriologist, I cannot tell you.

Q. Will you say there is not a chemical question involved in the inquiry I have just put to you?

A. No sir, I will not say there is not.

Q. Which of those trade wastes are richest in colloidal matters?

A. I should expect that the wastes from the tanneries, and the wool washings might be.

Q. Is there any provision in Complainant's Exhibit 135 for removing these colloidal matters?

A. It seems to me there are, that there is a certain result to be obtained.

Q. Can you remove colloidal matters by screening?

A. Not according to the screening that is there described.

Q. With coarse screening?

A. Well, both the coarse and the fine.

Q. Would you call four tenths of an inch mesh a fine screen?

A. I would.

Q. Is that your idea of a fine screen, Mr. Gray?

Mr. Riker: He did not say that. He said he would call it a fine screen.

A. It would be a fine screen to screen water, but it depends on the use of the thing as to how it may be termed.

Q. Are there finer screens in sewage disposal works?

A. There have been.

Q. Are they now in use, to your knowledge?

A. I cannot say. I have known burlaps to be used.

Q. That is a very fine mesh compared with this four tenths of an inch mesh, is it not?

3498 A. When you take into consideration all the fibrous matters that extend all through it, it is.

Q. Do you believe that any screening, no matter how fine will remove colloidal matters in sewage or from sewage.

A. I would not want to say that it could not be removed by a method of screening.

Q. How do you distinguish between colloidal matters and matters in solution, organic matters in solution?

A. I cannot tell you, sir.

Q. Do you mean to say there isn't any distinction?

A. I cannot tell you.

Q. Then how do you know colloidal matters can be removed by screening, if they are undistinguishable from organic matters in solution?

Mr. Riker: The witness has objected to because the witness has not said they are distinguishable.

The Commissioner: The objection of counsel for the defendants.

A. I cannot tell you, I don't know.

Q. Is there any provision in Complainant's exhibit 135 for removing organic matter in solution?

A. Just as you put the question, I should say not.

Q. Is any provision there for removing pathogenic germs or disease bearing germs from the effluent, prior to its discharge, in complainant's exhibit 135?

A. More or less of them, yes.

Q. How?

A. By the removing of the silts, which the coarser screens and finer screens and the sedimentation of the sewage will produce.

Q. By screening and sedimentation you can remove disease bearing germs, can you.

A. There will be more or less, yes sir.

Q. Removed?

3469 A. Yes sir.

Q. What percentage of them would you remove that way?

A. I cannot tell you.

Q. Would you remove half of that?

A. I cannot say.

Q. A quarter of that?

A. I would not wish to state.

Q. Would it not be as a matter of fact an infinitesimal amount that you would remove by sedimentation and screening?

A. I should not look at it in that way.

Q. Will you give me some approximation as to the percentage of just what you would remove?

A. I cannot in this case.

Q. Does septic sewage or fresh sewage contain more organic matter in solution?

A. I should expect that the septic sewage would contain more.

Q. And is the organic matter in solution in septic sewage more putrescible than the organic matter in fresh sewage—the organic matter in solution?

A. I think it is.

Q. And will more readily consume oxygen with which it comes in contact?

A. I should say it would more quickly do so.

Q. In speaking about those fine screens, do you know how fine the mesh is in the screens in the sewage disposal works at Dresden?

A. No sir.

Q. Do you know how fine the screens are in the sewage disposal works at Cologne?

A. No sir.

Q. Did I understand you to say that your knowledge of this Passaic Valley sewerage project was confined to your examination in 1902.

3500 A. I did not mean to be so understood.

Q. What part of your knowledge have you acquired since?

A. Since that time I have had the contract which has been referred to between the United States and the State of New Jersey, I have also have seen the plans as proposed to be carried out and have read more or less of the testimony given in regard to it, during the last two or possible three months.

Q. During the last two or three months your information and knowledge have been confined you say to this stipulation between the Federal Government and the State of New Jersey, a study of that?

Mr. Riker: The question is objected to because the witness did not say so.

The Commissioner: Note the objection of counsel for the defendants.

A. No sir, that is not my answer.

Q. What subject matter besides complainants' exhibit 135 have you had under consideration during the past two months?

A. As I have stated, more or less of the testimony given in this case, and the plans as shown me by the Chief Engineer, Mr. Brown, in his office, of what is proposed.

Q. How recently did Mr. Brown show you those plans?

A. I should not think it was a month ago.

Q. Was it a week ago?

A. Yes sir.

Q. How often have you looked at those plans?

A. I have looked at them once, through.

Q. How many volumes were there to the plans?

A. I could not tell you, I do not remember.

Q. Was there more than one?

A. I could not say, that did not attach itself to my memory.

Q. You looked at them over a week ago?

3501 A. More than a week ago.

Q. More than two weeks ago?

A. Yes sir.

Q. More than three weeks ago?

A. I would not say it was and I could not say it was not.

Q. You do not know how many volumes there were of those plans?

A. That I did not take in, we looked them over sheet after sheet.

Q. Did Mr. Brown show you more than one volume?

A. I cannot tell you.

Q. Do you know how many provisions in those plans have been made for the escape of sewage on certain occasions into the Passaic River and into Newark Bay?

Mr. Riker: The question is objected to on the ground that it is not cross examination and is immaterial and irrelevant to this issue.

The Commissioner: Note the objection of counsel for the defendants.

A. No sir.

Q. How recently have you examined the Passaic River?

A. You mean its full length I presume, or generally?

Q. From Paterson down or any substantial part of the river; state how much.

A. Not since 1903.

Q. You do not know whether it is worse now or better than it was in 1903?

A. Not from actual examination.

Q. Do you know how large the calibre of the Trunk Sewer is?

A. I have known but I cannot tell you now.

Q. Do you know whether or not the calibre has been decreased or diminished within recent times, that is since 1902?

A. I cannot say, I do not know.

Q. What plans of the Passaic Valley Sewerage Commissioners' project did you see, what date was on them?

A. I do not know the date, I did not observe the date.

Q. Do the plans which were submitted to you by Mr. Brown differ in any material fact from the scheme or plans described in complainants' exhibit No. 135?

A. In a general way I think not.

Q. Do you know when complainants' exhibit No. 135, which is a stipulation between the two governments in Washington and in Trenton, was executed?

A. No sir.

Q. Refresh your mind on that Mr. Gray.

Mr. Riker: He cannot refresh his mind; he had no part in it and I object to the question; this witness had no part in that stipulation and the stipulation itself shows when it was executed.

The Commissioner: Note the objection of counsel for the defendants.

Q. What do you understand to be the sewage disposal scheme that is now contemplated by the Passaic Valley Sewerage Commissioners?

A. To first screen the sewage, taking out the large floating matters; to provide grit chambers for the deposit of the grit; to provide screens, final screens and also sedimentation basins and pumping works and an outfall sewer or tunnel or whatever you may term it; the effluent to be discharged into forty feet of water near Robbins

Reef, through openings, as I judge, of about twelve inches; I forget just how many at this minute but a great many; also in the sedimentation plant baffle boards to catch any further floating matter, if there be any.

Q. Those are usually designed to retain grease, are they not?

A. Anything that is floating; they will retain grease or
3503 anything else.

Q. What is your opinion as to the efficiency of these contemplated multiple outlets?

A. Efficiency in what regard?

Q. As to dispersion?

A. I think they will be efficient.

Q. On what do you base that opinion?

A. On common sense.

Q. Have you ever had any experience with multiple outlets?

A. Not exactly like these, but similar.

Q. Where?

A. In discharging sewage into various streams in various places.

Q. Through multiple outlets?

A. Yes sir.

Q. Where?

A. In our own city, in Providence.

Q. You have multiple outlets?

A. I was going to explain what I mean by that. In our own city of Providence the sewage is discharged at various points through various sewers, each being an outlet, the whole of them constituting multiple outlets.

Q. They have the same condition on Manhattan Island, according to your knowledge now, have they not?

A. I cannot tell you.

Q. Do they discharge through one sewer or a number of sewers?

A. I do not know.

Q. By multiple outlets you understand a number of separate sewer outlets?

A. No sir, not in this case I do not.

3504 Q. Have you not described such a condition in Providence as multiple outlets?

A. In answer to your question whether I knew of any other multiple outlets, I did mention Providence, but those multiple outlets are not comparable with these multiple outlets; I do know however that the discharge of crude sewage into one place produces a different result from distributing it up and down a body of water, whether it be to one or more sewers or not and the same result that is obtained in that case in my judgment would be obtained in this, but to a far more perfect degree.

Q. Did you not state a little earlier in your examination the fact that sewage in Providence went to disposal works and was not discharged through the trunk sewers or through these sewers you have described?

A. I did, applying to the present.

Q. Then this multiple condition in Providence related to a previous condition?

A. Yes sir.

Q. And it is the ordinary mode of discharging sewage along the Passaic Valley now, through separate sewers; you call that a multiple discharge?

A. That may be classed as such; I do not call it a multiple discharge, as applied to this contract at all.

Q. My original question was whether you have had any experience with multiple outlets such as described in the plans that are now adopted by the Passaic Valley Sewerage Commissioners?

A. I beg your pardon; I failed to hear you say "such as are now", I failed to hear you connect those multiple outlets with this contract.

Q. Then what is your answer to it now?

A. No sir.

Q. Do you know of any such multiple outlet system in 3505 the world as is provided by the Passaic Valley Sewerage Commissioners' plans?

A. No sir.

Q. You have described the contemplated sewage disposal treatment work on the Newark Meadows, do you believe this can be operated efficiently without giving rise to any local nuisance or offense?

Mr. Riker: The question is objected to as irrelevant and immaterial and impertinent.

The Commissioner: Note the objection of counsel for defendants.

A. I think they can.

Q. Were the disposal works that you designed for Toronto ever installed that you know of?

A. I understand they were, I have been told.

Q. Are you quite sure that they were?

A. No sir.

Q. How long ago was that?

A. I cannot tell you but it was many years ago.

Q. You mentioned something about the sewage of New York City and that it was all discharged crude; Mr. Gray do you know whether there are any sewage disposal plants in connection with New York City?

A. No sir.

Q. Have you kept up your interest in Toronto and its sewage disposal system at all?

A. No sir.

Q. Are you aware of the fact that Mr. John D. Watson of England was called upon to design sewage disposal works there that are now in use?

A. Yes sir.

Q. Then you do know that Mr. Watson's design was accepted and is in use?

3506 A. But that was not your question; you asked me if I kept up my interest; I know some things I am not interested in; I know he was over here but I had no interest in that.

Q. Do you know whether or not he designed the works that are now in use in Toronto for sewage disposal?

A. I do not, no.

Q. Do you know of any sewage disposal plants that are used by New York City and where they are located?

A. I have already said that I do not.

Q. How old would you say Manhattan Island sewage was when discharged into either the Hudson or the East River?

A. I do not know.

Q. You would regard it as very fresh, would you not?

A. I think I misunderstood your question.

Q. (Previous question read as follows: "How old would you say Manhattan Island sewage was when discharged into either the Hudson or the East River?")

A. I don't know, sir.

Q. Would you say it was more than half an hour old?

A. I would not say.

Q. Does not the age of the sewage make a great deal of difference in considering the question of dilution?

A. In some respects it does.

Q. Do you need a greater measure of dilution for fresh or for septic sewage?

A. I should, my ownself, not speaking from scientific standards, but on my own judgment, wish for a greater dilution of fresh sewage.

Q. Is that your best judgment?

A. That is my best judgment.

Q. You mentioned something about the capacity of New York Bay for the assimilation or digestion of sewage; what factors would you take into consideration in measuring the digestive capacity 3507 of any body of water, to digest sewage?

A. I do not think that I did measure the capacity, as stated in your question.

Q. I understood you to say that you took in the biological and chemical features of dilution, in answering questions to Mr. Riker?

A. Yes, sir.

Q. And those were factors you were considering with the view of the digestion of sewage that would be discharged into the upper bay, were they not?

Mr. Riker: The question is objected to on the ground that neither in the direct examination nor elsewhere did this witness testify to the digestive capacity of the waters of New York Bay.

The Commissioner: Note the objection of the counsel for defendants.

A. Yes, sir.

Q. What do you mean by dilution with regard to sewage discharge?

A. The relative quantity of water into which sewage is discharged as compared with the quantity of sewage discharged into it.

Q. In discussing the question of dilution do you have in contem-

plation the question of assimilation by that body of water of the sewage discharged into it?

A. I do not get the meaning of your question.

Q. (Last question read.)

A. Yes, sir.

Q. So that when you are discussing questions of pollution, you have in mind the digestive capacity of the waters, based upon that dilution?

A. It may be put so, yes, sir.

3508 Q. The character of the water into which you discharge sewage you have to consider before you can discuss the question of dilution?

A. That should be considered.

Q. Taking up the question of the character of the water in the upper bay what would you say it was?

A. You will have to make that rather more definite; what would I say what was?

Q. What was the character, the condition of the water? However, I will withdraw that question.

In discussing the condition of water, what factors in that water will incline you to discuss later its powers of assimilation?

Mr. Riker: The question is objected to as so obscure as not to be pertinent to this inquiry.

The Commissioner: Note the objection of counsel for the defendants.

A. As I understand it, or, more probably, as I do not understand it, I cannot answer it.

Q. You do not understand the question?

A. No, sir.

Q. Does it make any difference whether water is low in its oxygen contents or high in its oxygen contents?

A. Make any difference in what?

Q. In relation to the sewage that you would contemplate adding, or discharging into it.

A. Yes, sir.

Q. What is the oxygen contents of New York Upper Bay?

A. I do not know, sir.

Q. Will that be a necessary factor to take into consideration before you add sewage to it in great volumes?

A. If you were going into it to a very refined point, yes.

3509 Q. Does it make any difference in your consideration whether water is already heavily polluted or not before you add an increased volume of sewage and expect it to dilute that increased volume of sewage?

A. Yes, sir.

Q. What percentage of the water that comes into New York Upper Bay on the flood has already been in New York Upper Bay, been heavily polluted, and gone out on the ebb?

A. I cannot tell you.

Q. Is not that a necessary factor for you to take into consideration?

A. If you are going into it in fine figure, it would be.

Q. What is the tidal prism of New York Upper Bay?

A. I do not remember.

Q. Have you given any study at all to the length of time it takes for sewage discharged into New York Bay to leave the upper bay?

A. I do not know that.

Q. Do you know how deep these deposits of sludge are on the bottom of New York Upper Bay?

A. No, sir.

Q. Do you know how low the oxygen contents is in New York Upper Bay?

A. I have seen statements of it but I do not remember.

Q. Referring to the multiple outlets, what would you expect the sewage to do immediately on its discharge from those multiple outlets?

A. To mingle with the water into which it is discharged.

Q. Is sewage lighter or heavier than salt or brackish water?

A. Generally, in the main, it is lighter.

Q. What is the salinity at Province where the effluents are discharged, what is the salinity of the water?

3510 A. I cannot tell it in figures, but salt.

Q. Quite salt?

A. Yes, sir.

Q. Is there any difference as to whether you discharge sewage into fresh or salt waters with respect — what becomes immediately of the sewage?

A. I should expect a quicker sedimentation in salt water.

Q. As a matter of fact does not salt water act as a precipitant of sewage solids?

A. To a limited extent it does.

Q. To what extent does it?

A. I cannot tell you.

Q. What would you say?

A. I do not know, I cannot state.

Q. What is the salinity of New York Upper Bay?

A. I do not know.

Q. Will the sewage discharged at these multiple outlets rise vertically until it reaches the surface of the water of the Upper Bay?

A. I do not expect it will.

Q. Why?

A. I expect the current will carry it laterally, more or less.

Q. How would it be on slack waters?

A. I should expect the same, possibly to a less extent.

Q. Do you know of the currents in New York Bay?

A. I do not know of them.

Q. What do you know of the phenomena of the underrun?

A. I do not know.

Q. Is it not a uniform experience with sewage disposal systems

that sewage invariably rises from the outfall to the surface of salt water?

3511 A. I think you may call it uniform.

Q. You have read the stipulation, as set forth in complainants' exhibit No. 135, carefully, have you not?

A. The one that was handed to me?

Q. Yes.

A. Yes sir.

Q. And you have studied the character of the effluent stipulated for?

A. Yes, in that I have carefully read the stipulation.

Q. What objection would you have to discharging the effluent such as that which is provided for in complainants' exhibit No. 135, into Newark Bay?

A. Nothing.

Q. You do not see any possible reason why it should not be discharged into Newark Bay, do you?

A. Yes sir, but not in accordance with this stipulation.

Q. I am confining myself to the stipulation, what it stipulates for.

A. That is to be discharged into forty feet of water; you could not do it in Newark Bay.

Q. But I am asking about the effluent; if you will turn to the six provisions for the effluent, which it is to live up to; let me direct your *opinion* specifically to what is in my mind:—Directing your attention to page 3 of complainants' exhibit No. 135 I ask you if an effluent as good as it is therein stipulated for, if it would occasion any injury or nuisance if discharged into Newark Bay?

Mr. Riker: Objected to on the ground that the stipulation is for an effluent which will produce certain conditions in New York Bay and not for an effluent described generally, as a specific thing. The stipulation is confined to New York Bay and I therefore object to the question on the ground that it is irrelevant, immaterial and impertinent.

*3512 The Commissioner: Note the objection of counsel for the defendants.

A. I want to answer that question a little more than yes or no.

Q. As fully as you please, we are trying to get the whole facts.

A. The question asked me to express an opinion on only one-half the conditions; only one-half of the conditions, or only a part of them at any rate have been mentioned in the question. This effluent is to be discharged into deep water under different conditions than Newark Bay contains.

Q. Let us clear up that point. Will the effluent stipulated for in complainants' exhibit No. 135 differ in any particular, whether it is discharged into Newark Bay or into New York Bay?

Mr. Riker: The question is objected to on the ground that the stipulation is separate as to the processes and methods of the production and as to the results guaranteed in New York Bay and therefore the question should be made more specific, and divided. If the part of the stipulation referred to is the effluent produced by the

process, that is one thing; if the part of the stipulation referred to is the guaranteed results in New York Bay, that should be so stated. The question is objected to as being indefinite.

The Commissioner: Note the objection of counsel for the defendants.

A. I must confess that I may be dense, but I do not catch the meaning of the question.

Q. Directing your attention to page 3 of complainants' exhibit No. 135 I ask you to read what stipulations there are made relative to the kind of effluent that would be discharged at Robbins Reef?

3513 Mr. Riker: The question is objected to because it calls for a conclusion and does not call for the reading of the stipulation. The stipulation speaks for itself and should be read with that view.

The Commissioner: Note the objection of counsel for the defendants.

A. (Reading:) "There will be an absence in the New York Bay of visible suspended particles coming from the Passaic Valley sewage.

There will be an absence of deposits objectionable to the Secretary of War of the United States, in the New York Bay, coming from the Passaic Valley sewage.

There will be absence in the New York Bay and its vicinity of odors due to the putrefaction of organic matters contained in the Passaic Valley sewage thus discharged.

There will be a practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley sewage at the dispersion area of elsewhere.

There will be no injury to the public health which will be occasioned by the discharge from the said sewer into the bay of New York in the manner proposed and no public or private nuisance will be created thereby.

The absence of injurious effect from said sewage discharge upon the property of the United States situated in the Harbor of New York."

Q. Now, Mr. Gray, having read the kind of effluent stipulated for in complainants' exhibit 135 and contemplated in that stipulation to be discharged at Robbins Reef, I ask you where that effluent will be produced in the condition that you have now read, and after you have examined the plans of the sewage disposal system on the Newark Meadows?

Mr. Riker: Objected to on the ground that the witness has
3514 not read the kind of effluent that will be produced but on the contrary has read the stipulation which is a stipulation as to results from the effluent and not a description of the kind of effluent.

The Commissioner: Note the objection of counsel for the defendants.

A. I do not understand that I have read a kind or condition of effluent, I have simply read what the results must be.

Q. Where would the effluent be produced?

A. According to this stipulation?

Q. Yes.

A. At the point of discharge.

Q. How about the sewage disposal system, after the sewage is treated in the sewage disposal system, what is about to be discharged, don't you call that an effluent?

A. I should call it the effluent when it comes out of the pipes.

Q. And not when it left the sewage disposal works?

A. Not necessarily.

Q. What change takes place in the matter after it leaves the sewage disposal works and before it reaches the outfall?

A. I cannot tell you.

Q. Do you know of any?

A. I should presume it would be more septicised.

Q. More septicised in New York Bay than in Newark Bay?

A. No sir, that is not what I meant.

Mr. Riker: That was not the question at all.

Q. Where would it be more septicised?

A. Between the points you have already mentioned.

Q. Between the Newark meadows and New York Bay?

A. Newark meadows? I thought you spoke of the Newark Bay a few moments ago.

Q. Do you understand that this sewage will be collected from the entire Passaic Valley and brought to a sewage disposal works
3515 on the Newark Meadows?

A. With the exception of such cities as do not join.

Q. Such cities and townships as do contribute the sewage?

A. That will all be taken in the same trunk sewer.

Q. To the Newark Meadows, is that right?

Mr. Riker: The question is objected to on the ground that it does not state what the witness said, and is not the truth; my objection to the question is that it does not state the facts contained in the witness' testimony.

The Commissioner: Note the objection of counsel for the defendants.

Doctor O'Sullivan: Please read the question?

Q. (Question read to witness as follows: "Such cities and townships as do contribute the sewage, that will all be taken in that trunk sewer to the Newark Meadows. Is that right?")

Do you understand it so?

A. May I read my understanding of it.

Q. Yes.

A. (Reading: "Upon the line of the Trunk Sewer which it is proposed shall be constructed and at a point at or near the Pumping Station to be located on the Newark Meadows near the Newark Bay, it is stipulated and agreed that the sewage, waste and other matter passing through the said Trunk Sewer shall first pass through coarse screens to remove therefrom all large floating matter, and after pass-

ing through such coarse screens shall pass through a grit basin or basins where the heavy matter therein shall be taken out as far as practicable, from which basin or basins the sewage and other matter shall pass through self-cleansing mechanical screens having clear openings of not over $4/10$ of an inch."

Q. Where does all that occur?

A. Where it says.

3516 Q. Where?

A. I will read it again.

Q. I have asked you the location of the plant?

A. On the Newark Meadows.

Q. After being treated by screening, sedimentation and grit chambers what do you call the matter that is about to be discharged; do you call it an effluent?

A. Not taken in connection with this stipulation, no, but in connection with simply these works you mention anything is an effluent that comes from them.

Q. Yes?

A. But it is not an effluent in my judgment in the proper understanding of this stipulation; the effluent will occur when it comes out of the openings.

Q. Will you describe what you mean by the term "effluent" so that we can understand each other?

A. The effluent chamber is a chamber from which the water comes out; the effluent of the works will be the effluent at the works; the effluent of the whole sewerage works will be the effluent at the outlet where these 150 large outlets are.

Q. Do you understand different kinds of effluents, by the description you have given?

A. Oh no.

Q. Do you call the matter that leaves, and is about to be discharged from, the disposal works, an effluent?

A. That is an effluent from the disposal works.

Q. There is one effluent from the disposal works and another effluent from the outfall, is that it?

A. That is it.

Q. What occurs to the effluent that leaves the disposal works before it becomes the effluent at the outfall; what changes occur in its character if you know?

A. In the first place it gets sadly torn up by the pumping.

3517 Q. Yes.

A. Thoroughly mixed, and I have already answered that question by saying that it might be slightly more speticised.

Q. If the effluent at the time it reaches the outfall is as good as if it is stipulated for in Complainants' Exhibit No. 135, does it make any difference where it is discharged; won't it give the same result?

Mr. Riker: The question is objected to on the ground that there is nothing in the stipulation which says how good or how bad the effluent is when discharged; the only stipulation being as to the result to be produced in New York Bay.

The Commissioner: Note the objection of counsel for the defendant.

A. I do not understand the stipulation states how good the effluent shall be, the quality.

Q. What do you understand those six provisions you read a little earlier relate to?

A. Results.

Q. In what way do they relate to the effluent?

A. The results which the effluent shall or shall not produce on the waters in which it is discharged.

Q. Would those results differ if that effluent was discharged in the lower bay from what they would be if discharged in New York Upper Bay?

A. They might, I do not know.

Q. Have you any knowledge on the subject?

A. No sir.

Q. How would it differ then whether it was discharged in Upper New York Bay, in lower New York Bay or in Newark Bay?

A. I have already said in regard to the two first questions, or the first two parts, I do not know.

Q. How would it differ if it were discharged in New York Bay or in Newark Bay, if it was the same effluent that is stipulated for in Complainant's Exhibit No. 135?

Mr. Riker: The question is objected to on the same ground that has been urged on several occasions—that the effluent itself is not stipulated for nor described, but the results to be produced in New York Bay only are stipulated for and that it might well be that an effluent to produce those results in Newark Bay would be a very different effluent than the effluent which would produce the results in New York Bay.

The Commissioner: Note the objection of counsel for the defendants.

A. I must claim that I have stated to me what that kind of effluent is; the question I cannot answer, I do not think it can be answered. The results are what are stipulated for and if those same results were obtained in Newark Bay that are stipulated for in New York Bay, why then there would be no difference.

Q. Would you expect the same results from the discharge of the effluent under the stipulation contained in Exhibit 135 if the same treatment was applied as described in Complainants' Exhibit No. 135?

A. I cannot answer that mixed condition; I can simply say that these results called for, if produced in Newark Bay would be the same as in New York Bay.

Q. You have read the whole stipulation, have you not?

A. Yes sir.

Q. Complainants' Exhibit No. 135 I mean?

A. Yes sir.

Q. What objection would there be to discharging the effluent

provided for in this stipulation, what results from that effluent, what objection would there be to discharging that effluent in New-ark Bay?

3519 Mr. Riker: The question is objected to on the same ground that has been repeated several times, that the effluent is not stipulated for but that the results are stipulated for.

The Commissioner: Note the objection of counsel for the defendants.

A. I can only repeat what I have said, that the effluent is not stipulated, it is simply the results.

Q. You just heard Mr. Riker make that statement, have you not?

A. I made that statement I think before he did and I have just heard him make it again.

Q. Did you originally make that statement to Mr. Riker?

A. I will say if I did, you have heard it, because all the statements I have made to him, practically, you have heard this morning. I do not remember making such a statement to him.

Q. Do you make a distinction between an effluent and the result of an effluent upon a body of water into which it is discharged?

A. There could be, yes sir.

Q. So that a good effluent might give bad results and a bad effluent give good results, is that it?

A. If you will state some more conditions; I think that a good effluent emptied into drinking water might give bad results.

Q. And a bad effluent emptied into drinking water would give good results, which is the converse of the proposition you stated?

A. Is that a question or a statement?

Q. I ask you if that is so (last question read to witness)?

A. No sir.

Q. Do you make a distinction between the effluent itself and the injury or benefit which may flow from it?

A. Those points are of course considered.

Q. Is any effluent stipulated for in Complainants' Exhibit No. 135?

3520 A. I do not remember that there is, simply the results.

Q. And were those results good?

A. I should think they were.

Q. Would you infer a good effluent from the good results?

Mr. Riker: The question is objected to on the ground that it is indefinite; that in order to answer the question and make it specific it is necessary to state the conditions under which the effluent is to be discharged and the character of the body of water into which it is to be discharged.

The Commissioner: Note the objection of counsel for the defendants.

A. I will add to my other answer by saying I should think they were, for these conditions.

Q. What difference obtains in New York Bay from Newark Bay regarding the reception of such an effluent and its results as are stipulated for in Complainants' Exhibit No. 135?

Mr. Riker: The question is again objected to on the ground that the character of the effluent is not stipulated for in this stipulation and the question therefore is based upon a misstatement of facts.

The Commissioner: Note the objection of counsel for the defendants.

A. I don't know how to answer that question.

Q. Where will the effluent stipulated for in Complainants' Exhibit No. 135 be produced?

A. There is none stipulated that I know of.

Q. What matter gives the results that are called for in Complainants' Exhibit No. 135 and at page 3 of that exhibit?

Mr. Riker: The question is objected to on the ground that it is not directed to any particular matter and therefore is obscure and incapable of being answered.

3521 The Commissioner: Note the objection of counsel for the defendants.

Q. It has no relation to a sewage effluent, has it?

A. It states what the results of that sewage effluent shall produce and shall not produce.

Q. Where does it use the word "effluent"?

A. In those six paragraphs?

Q. The word "effluent" where does it occur?

A. You mean in those six paragraphs?

Q. Anywhere in the stipulation?

A. I fail to find that the word is used.

Q. What does the whole stipulation relate to, meaning the stipulation your attention is now directed to, being Complainants' Exhibit No. 135?

Mr. Riker: Objected to on the ground that the stipulation, being a document in evidence, speaks for itself.

The Commissioner: Note the objection of counsel for the defendants.

A. That is very indefinite; it might relate to quite a few things; the main point is the disposal of the sewage through this Trunk Sewer.

Q. Does not the whole stipulation as you understand it relate to the treatment that sewage will receive before it is discharged into New York Bay and the product or effluent from that treatment?

A. Not that alone, it relates to the results that that will produce, also.

Q. The results from what?

A. From the discharge of such sewer into the bay of New York.

Q. What will be discharged from those multiple outlets?

3522 A. What we have been calling an effluent?

Q. Where is that effluent produced?

A. Its final production is at the discharge of these 150 outlets.
 Q. Does it receive any treatment after leaving the sewage disposal works on the Newark Meadows, under that stipulation?

A. I have several times said that the only change I can conceive of is that it may be slightly more septicised.

Q. And that would be a change for the worse?

A. I do not think so.

Q. You think sewage is better when it is septic than when it is fresh?

A. I think the effluent from septic tanks is more easily treated oftentimes than fresh sewage.

Q. Yet I understood you to say a little while ago that you did not know whether the septic sewage demands more oxygen and exhausts the oxygen contents of water more than fresh sewage?

A. I do not remember having made that statement.

Q. I put it to you as a question, does fresh or septic sewage more rapidly exhaust the oxygen contents of water into which either or both are discharged?

A. I should look for the septic sewage as rather more quickly taking up the oxygen.

Q. What kind of an effluent under the plans that you have been studying regarding the Passaic Valley Trunk Sewer project and the sewage disposal works and the treatment that the sewage would receive would be produced?

A. An effluent which I think would give those results.

Q. And that effluent would be produced, at the works?

A. As I have just stated, the final effluent would be produced—discharged—at the outlets.

Q. The final effluent?

A. Yes, sir.

3523 Q. But the effluent produced at the works, would the effluent give the results stipulated for in complainants' exhibit No. 135?

Mr. Riker: Objected to on the ground that the witness is asked to guess as to conditions which are not in the case and are not in existence; the effluent produced at the works is not the effluent to be discharged at the point near Robbins Reef but that is an effluent discharged through an outfall sewer with multiple outlets, at a certain depth of water.

The Commissioner: Note the objection of counsel for the defendants.

A. I think the effluent which would be discharged from the outlets will produce the results enumerated in the stipulation.

Q. I will repeat my question. (Last question read.)

A. I want to answer your question, I want to answer it freely, but there is no effluent stipulated. When you are speaking of the effluent, that means the material discharged from the sewer, all that is stipulated with regard to that effluent is what the results of it shall be under those conditions, emptied as they propose.

Q. You have studied the sewage disposal system contemplated to be erected on the Newark Meadows, have you not?

A. In the way that I have stated, yes sir.

Q. What kind of an effluent would those works produce?

A. I cannot give you any different answer than what I have said; they will produce an effluent that will give those results.

Q. If that effluent produced at the works and yielding the results you have just stated would be equal to those stipulated for in complainants' exhibit No. 135, would such an effluent injure Newark Bay if discharged into it?

A. I cannot say.

Q. Would you expect injury from it?

3524 A. I cannot say, I cannot answer that question.

Q. Would you expect such effluent to contain visible suspended particles?

Mr. Riker: I object to the question on the ground that it is indefinite in that it does not specify where, the point at which, or the conditions under which it might produce visible suspended particles.

The Commissioner: Note the objection of counsel for the defendants.

Q. (Last question read.) If discharged at the most favorable point in Newark Bay?

A. Without having studied it with reference to that point of discharge, I cannot say.

Q. Would you expect, with such an effluent discharged at the most favorable point in Newark Bay that there would be an absence of deposits objectionable to the Secretary of War?

A. My answer to that would be the same as my answer to your last question.

Q. Would you expect from such an effluent the absence of odors at the point of discharge or in its vicinity when discharged at the most favorable location in Newark Bay?

A. I make the same answer.

Q. Would you give the same answer to the fourth stipulation as to the results relating to grease or color and under the same conditions?

A. Yes sir.

Q. And you would make the same answer, would you, to the fifth item of the stipulation regarding injury to public health under like conditions as I have just embodied in my other questions?

A. Yes sir, with this to be said, that the conditions are very different; I should give the same answer.

Q. Directing your attention to the sixth item of the stipulation on page 3 of complainants' exhibit No. 135, assuming the same condition of facts, would your answer be similar in regard to the absence of injurious effects from such sewage discharge upon the property of the United States or otherwise?

3525 A. I should have to know more fully the location of the property of the United States, which I am not familiar with.

Q. Or other property in the vicinity of Newark Bay—substitute “other property” for “United States property”?

A. Private property?

Q. Yes.

A. My answer would be the same as before, to the other five.

Q. Assuming the same condition of facts would you expect absence of reduction in the dissolved oxygen contents of the waters of Newark Bay resulting from the discharge of this effluent that we have been discussing?

Mr. Riker: Objected to on the ground that there is no stipulation anywhere in regard to the actual quantity of dissolved oxygen and that the question is not based, as a hypothetical question, upon any facts in this case.

I want the witness to have his attention directed to the stipulation and that the dissolved oxygen relates to major fish life and not to the actual quantity of dissolved oxygen.

The Commissioner: Note the objection of counsel for the defendants.

A. The last question regarding the 7th is more difficult than any of the others. I should give the same answer however to No. 7 as I have to the six preceding ones.

Q. Would that effluent after it left the sewage disposal works on the Newark meadows be improved in any particular in its transit to the multiple outlets in New York Bay?

A. I think I have answered that question several times; it 3526 might be slightly more septicised.

Q. Would you regard that as an improvement?

A. Leaning that way, yes sir.

Q. Although it would exhaust oxygen more rapidly than if it were not so septic?

A. I have stated, sooner, but I have not stated that it would absorb more oxygen than the fresh sewage, take it up quicker.

Q. How does fresh sewage absorb oxygen?

A. I don't know, I am not a chemist.

Q. Don't you know that is not a chemical question?

A. No sir.

Q. Don't you know that it is a biological question?

A. Partly it may be, but I am not a biologist.

Q. Do you know which of those two—

A. I will have to let you state that.

Q. In 1902 when you made your examination of the Passaic River were you not in favor of the discharge of sewage into the Newark Bay?

A. I do not remember that I was, and if the plan at that time contemplated discharging it into Newark Bay I recommended Paterson to join the trunk sewer rather than put up works of their own.

Q. And did not they call upon Mr. Hazen later to make a report and did he not substantially make a report that they ought to dispose of their own sewage in preference to entering into the trunk sewer scheme.

Mr. Riker: The question is objected to on the ground that the answer would necessarily be hearsay and that if Mr. Hazen's report is material to this case it should be proved regularly.

The Commissioner: Note the objection of counsel for the defendants.

A. My answer was going to be just what Mr. Riker has given, I only know it by hearsay, I have no evidence of it.

3527 Q. Was the report you made to the City of Paterson published?

A. No sir, not that I know of, I cannot say.

Q. Was it an oral or a written report?

A. It was a typewritten report.

Q. That was in what year?

A. The latter part of 1902 was the examination, most of it, and the report was published, I think in 1903, the early part.

Q. Do you remember what the date of Mr. Hazen's report was?

A. No sir.

Q. Do you know whether that was printed or not?

A. I do not.

Q. Have you seen a copy of Mr. Hazen's report that you know of?

A. Not that I remember.

Q. Have you ever studied any report in relation to the Passaic Valley trunk sewer scheme, and separate disposal systems for the Passaic Valley water shed?

Mr. Riker: The question is objected to on the ground that it does not appear there are any such.

The Commissioner: Note the objection of counsel for the defendants.

A. It seems to me the question is, if you will excuse me for saying so, contradictory, I do not understand what you want to express to me.

Q. You fail to understand my question?

A. Yes sir, I do.

Q. Have you read any reports for any scheme of sewage disposal in relation to Passaic Valley, or any of its municipalities?

Mr. Riker: The question is objected to as not being cross examination, and immaterial and irrelevant in any view.

The Commissioner: Note the objection of counsel for the defendants.

3528 A. Do you mean disposal of separate municipalities?

Q. Either for separate disposal or for a trunk sewer scheme.

A. All I have read is my own report and portions of what Mr. Herring made.

Q. How long ago was that?

A. My report, as I have said, was made in 1903; I do not remember that I have read it since; it was several years since that I read Mr. Herring's report, I cannot say how long since.

Q. Before 1906, was it not?

A. I would not undertake to fix the date.

Q. Do you recall enough of his report to say whether or not it contemplated the discharge of crude sewage?

A. I do not remember.

Q. Did you ever read the Passaic Valley Sewerage Commissioners report, or any of their reports?

A. I think I have; I have read what I should suppose you meant by that, a report to his Excellency Franklin Murphy, dated June 8, 1903, in which are also gathered reports from various other parties.

Q. And that was the last of the reports that you have read, was it?

A. I do not know.

Q. Do you not recall any others?

A. No, sir, I do not recall whether I did or not.

Q. Will you say positively that there were others than the one which you have just produced?

A. No, sir, I won't say either way positively.

Q. How many towns and municipalities is this trunk sewer project contemplated to serve?

A. I cannot state the number, but those bordering on the Passaic Valley, with the exception of a few, my impression is three or four possibly.

Q. Do you know whether that trunk sewer project of the
3529 Passaic Valley Sewerage Commissioners contemplates serving those communities for the dry weather flow or for storm and dry weather flow?

A. I understand it is for the dry weather flow plus more or less ground water which would inevitable get into the sewers, plus possible the first flush of a storm, but not what we would term storm sewers.

Q. What is the precipitation of the Passaic Valley water shed?

A. I cannot tell you now; I have had that; I should think in the neighborhood of forty odd inches, but — is so long since I dealt with that that I do not remember.

Q. Are you familiar with the number of rainy days they have here, with the general conditions of precipitation?

A. In a general way, but I could not tell you how many rainy days they have here.

Q. What percentage of the flow will this trunk sewer project accommodate during an ordinary wet day along the Passaic water shed?

A. I cannot tell you, I do not know.

Q. Will it be able to handle ten per cent of it?

A. I don't know.

Q. What percentage of the trade wastes is it contemplated will be carried in this trunk sewer?

A. I understand generally the total wastes, with the understanding that that waste is to be reduced as far as it can be by the manufacturers.

Q. What percentage of that?

A. I cannot tell you the percentage.

Q. Don't they take all of it?

A. Just as I have said, I understand they take the waste less what they can prohibit going into the sewers, without injury.

Q. What provision is made in the Passaic Valley trunk sewer project for the surplus during a rain storm?

A. Surplus of what?

Q. Of flow.

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendants.

A. Do you mean the surplus of the rain fall?

Q. Yes, the rain fall and sewage; they get mixed, do they not?

A. Yes.

Q. How do they handle that surplus if this project is calculated to deal with the dry weather flow?

A. As I have stated the first flush of the storm as I understand will be taken in the trunk sewer; what may come from the district will go into the Passaic River.

Q. Will go right into the Passaic River?

A. I so understand it.

Q. And that would be a mixture of sewage, trade wastes and storm water?

A. It would to that extent, but a very much diluted extent.

Q. It would be sewage and trade waste diluted.

A. That is what I have said.

Q. Would you expect the first flush of a storm always to go into this trunk sewer?

A. I do not see why it would not.

Q. After it had been running awhile they would have to let out the accumulated sewage, trade waste and storm water at various outlets into the Passaic River itself; is that correct?

Mr. Riker: The question is objected to on the ground that it relates to conditions existing in the State of New Jersey, and has no relation to the issue which is the supposed threatened creation of a nuisance in New York Bay.

3531 The Commissioner: Note the objection of counsel for the defendants.

Dr. O'Sullivan: Counsel for complainant presses this line of questioning because it tends to show that this trunk sewer project will not be sufficient for the purposes contemplated in its very design, and will not reduce the offensive condition already existing in the Passaic River.

Mr. Riker: Counsel for the defendants rests his objection to the question on the ground that it is none of the complainants' business whether it will or will not; it is an impertinent inquiry.

A. Answering the question, which is comprehended in three words "is that correct" relative to the statement which I understand you to have made, I should say that I do not know.

Q. You made a distinction a little while ago between the effluent

which left the sewage disposal works on the Newark meadows, and the effluent that was to be discharged from the multiple outlet in New York Bay; how do you understand that effluent from the Newark meadows was to be transported to New York Bay?

A. May I first ask what distinction I made; I do not remember?

Q. Your distinction, as I remember it was, that it would be more septic.

A. Slightly more; as I understand, that sewage is to be transported in a tunnel sewer, or whatever name you may give it.

Q. What is to be the construction of that channel of transportation?

Mr. Riker: The question is objected to as irrelevant, immaterial and impertinent.

The Commissioner: Note the objection of counsel for the defendants.

3532 A. I cannot recall the details of that construction.

Q. Was it to be brick?

A. My recollection of it is that some of it was.

Q. Mostly brick.

A. Well I cannot say as to most of it, some of it was iron pipe, as I recollect.

Q. Iron pipe and brick; do you know how long the tunnel made of brick and iron, that is to transport this—

A. No, I cannot discriminate.

Q. How was it to lay in regard to Newark Bay, a little below the surface, or on the surface?

Mr. Riker: I object to the question on the grounds last stated.

The Commissioner: Note the objection of counsel for the defendants.

A. The impression I had is that it is to be laid sufficiently deep to be out of the way of any future improvement which may be made to the harbor.

Q. How was it to be carried across the Bay, on the peninsular?

Mr. Riker: I enter the same objection.

The Commissioner: Enter the objection of counsel for the defendants.

Q. With brick or iron?

A. Across the Bay, on the peninsular?

Q. Yes.

A. I do not remember.

Q. Then after it reached New York Bay it would dip deep enough into the water to give it a forty foot discharge, is that right?

A. I so understand it.

Q. Do you know what percentage of the entire expense of the Passaic Valley trunk sewer project that mode of conducting the effluent from the Newark Meadows to New York Upper Bay
3533 would represent?

Mr. Riker: Objected to on the ground that it is irrelevant,

immaterial and impertinent; does not concern this complainant and is not related in any way to any issue in this cause, and the witness is privileged under the advice of counsel not to attempt to answer.

The Commissioner: Note the objection of counsel for the defendants.

Witness: Am I to answer that, your Honor?

The Commissioner: You may do as you please.

A. I do not know.

Q. How many outlets are there for the overflow from the trunk sewer, do you know, between Paterson and Newark?

Mr. Riker: I make the same objection as last stated.

The Commissioner: Note the objection of counsel for the defendant.

A. No sir.

Q. Do you know whether or not there are fifty?

Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. I do not know.

Q. A little earlier in our discussion we found that you had discarded the chemical mode of precipitation as a method of sewage disposal; is the general practice now to discard the septic tank as well as the chemical method of sewage disposal?

Mr. Riker: Objected to on the ground that this witness is testifying under oath in answer to questions and is not discussing anything with counsel for the complainant, and therefore, the question ought to be stricken from the record.

The Commissioner: Note the objection of counsel for the 3534 defendants.

A. It is news to me that I have discarded that method, when that method would be the best.

Q. The chemical precipitation?

A. I have not stated that I have discarded it in any of my testimony.

Q. You installed it in Providence, and I understood you to say it has been discontinued.

A. You entirely misunderstood my answer.

Q. Where did you install it?

A. At Providence.

Q. And it is still in use there?

A. Certainly, every day.

Q. Chemical precipitation?

A. Yes, sir.

Q. Is the general practice among sewerage disposal operators in favor of or against chemical precipitation?

A. I think there are not as many enthusiastically in favor of it as there were many, many years ago.

Q. How would you say as to septic tank treatment?

A. What do you mean, that question is very indefinite to me?

Q. Is that a favorite method, to dispose of sewage by the septic tank method, now, or is it in disfavor?

A. The Cameron people think it is very acceptable, they are very much in favor of it, and many engineers are today; some are not as enthusiastic about it as they were a few years ago.

Q. How are you individually?

A. I want to see the place, and then I will answer.

Q. Is the effluent from a septic tank more easily or less easily treated, than the effluent such as is described in complainant's exhibit No. 135?

A. Treated how, by what method?

3535 Q. By any method?

A. I cannot answer a question as indefinite as that.

Q. What kind of an effluent does a septic tank yield?

Mr. Riker: I object to this question until the witness be informed as to what the septic tank is and what the sewage treated by it is; the question is not made definite enough for him to answer.

The Commissioner: Note the objection of counsel for the defendants.

A. If I know what you mean by "such kind" I will try to answer your question.

Q. Have you ever had any experience with septic tanks?

A. Yes, sir.

Q. Where.

A. For the state institutions of Rhode Island.

Q. What is the object of septic tank treatment?

A. The treatment of sewage has been something like the development of the locomotive, little by little, changing and changing; it is something like the development of the practice of medicine and surgery, improvements from year to year. The septic system was an advance in some places over chemical precipitation; where land could not be obtained in sufficient quantities for sand filtration it has been adopted, filtering the effluent afterwards with more ease and less labor than you could filter the crude sewage. I do not know how far you want me to keep on with the several steps.

Q. The mere fact that there are stages is what I was after.

A. Yes, everything goes in stages, whether it is theology or whether it is medicine, or whether it is mechanics. I was going to add that just now—

Q. What I was getting at is this; is it not a fact that chemical precipitation was fairly popular in this country and is it
3536 not now somewhat obsolete, having been succeeded by the septic tank which in its turn has also become obsolete?

A. I cannot say yes to that; I will say, however, that it was more popular years ago than it is today, but I will not admit that neither is obsolete. I was about to add that the next step from the septic

takn was the Imhoff tank which is supposed to be somewhat of an improvement.

Q. But the general trend of the profession is to get away from the septic tank now, is it not?

A. I could not say that it is, I would not be so emphatic as that.

Q. How long is it since you have built or installed any large sewage disposal system?

A. I have just now, within a few weeks, completed one for Albuquerque, New Mexico, quite a system.

Q. What is the population there?

A. I am not positive, I should think thirty or forty thousand. I have more recently installed and built some ninety miles in San Antonio, Texas.

Q. For what population to be served?

A. My recollection is it was nearly one hundred thousand. I have recently been consulted with regard to the Worcester sewage, the population there amounting to about one hundred and fifty thousand.

Q. One hundred and fifty thousand in San Antonio, Texas?

A. No, Worcester, Massachusetts.

Q. Did you design and build those works there?

A. No, sir. Part of them, yes sir, and part of them, no sir. As stated in the early part of my testimony I was appointed as one of three to design the reconstruction of those sewers, and the reconstruction of the works for the disposal of the sewage.

3537 Q. Who did the major part of those works at Worcester?

A. Mr. Allen, in the early part, Mr. Charles Allen.

Q. Was Mr. Eddy connected with them?

A. Yes, he was, concerned in the sewer, for quite a while, but Mr. Allen was City Engineer.

Q. You have said you have read some of the testimony; whose testimony did you read that has been given in this case?

A. I can give you the names but I do not think I can separate the testimony; some of it was given by Mr. Eddy, some by Dr. Mason of Troy, and I think by Mr. Hayden, some of it, and some by Mr. Fitzgerald.

Q. Who is Mr. Fitzgerald?

A. He was engineer of the water works in Boston for a good many years.

Q. Did you know him when he was president of the American Society of Civil Engineers?

A. Yes, sir.

Q. Who is Dr. Mason?

A. He is at the head of the Polytechnic Institute at Troy.

Q. An eminent man?

A. Yes, sir.

Q. Did you read any of Mr. Eddy's testimony?

A. I did, as I said I do not know as I could distinguish what each testified to.

Q. Do you regard Mr. Eddy as a very able man?

A. Mr. Eddy is an able man.

Q. Did you read any of Professor Sedgwick's testimony?

A. Yes sir, I read some of that.

Q. Who is Professor Sedgwick?

A. He is connected with the School of Technology at
3538 Boston.

Q. At the head of the Massachusetts Institute of Technology?

A. Yes sir.

Q. Do you regard him as an eminent sanitarian?

A. Why yes.

A recess was then taken.

Redirect examination by Mr. Riker:

Q. Your knowledge of trade wastes in the Passaic Valley district was obtained in connection with your report to the City of Paterson, was it not?

A. Yes sir.

Q. And in the consideration of a separate disposal plant for Paterson did you or did you not plan to take care of that trade waste?

A. Some of it yes sir, particularly the wool washings.

Q. Assuming that all of the trade waste in this district are to be excluded from the sewer except ten per cent, in your opinion will that be any factor in the effluent as discharged into New York Harbor?

A. You refer to all the manufactories in the valley?

Q. Yes, all but ten per cent is removed.

A. I do not think it will be any serious factor at all.

Q. You testified on cross examination that the removal of the solids that will be accomplished by the works proposed on the meadows, in connection with the Passaic Valley sewer, in your judgment will remove a part of the pathogenic germs in the sewage?

A. Yes sir.

Q. Is there any process of destroying the pathogenic germs that could be applied at the tanks on the meadows when in operation?

3539 A. Yes, soda ash, or some such chemical.

Q. A germicide could be applied in the tanks?

A. Yes sir.

Q. Do you know whether sewage moving at the rate of three feet a second will become septic more quickly or less quickly than sewage that is in a state of rest?

A. I should say less quickly.

Q. Do you know the rate of discharge estimated for the sewage in the Passaic Valley sewer?

A. I do not remember.

Q. You have made some observations in the past as to the condition of the Passaic River above Newark, I think you said?

A. Yes sir.

Q. And I think you said that you found septic conditions existing there?

A. Partially, approaching that—the beginning.

Q. What is the dilution of the sewage discharged into the Passaic River, by the waters of the river at Newark; considerable or inconsiderable as compared with the dilution in New York upper bay?

A. Comparatively I should say very much less.

Q. And has that less amount of dilution any relation to the conditions you found or observed at Newark in the Passaic River, with relation to the septic condition of the river?

A. Do you mean by that question the effect of those works on the sewage in the Passaic River?

Q. No, I mean by that to ask you whether the inconsiderable dilution of the sewage discharged into the Passaic River was a factor in the resultant septic conditions that you have observed?

3540 A. Yes sir.

Q. Given a definite sewage discharge, or a discharge of liquids contaminated with organic matter, will the discharge of that sewage matter into a large body of water in your opinion be attended with different results from what it would be attended with when discharged into a comparatively small body of water?

A. Yes sir, because it would dilute it more.

Q. If discharged at a depth of forty feet, in your opinion would that have any results as to the observed conditions produced by it, different from a discharge at a depth of fifteen feet?

A. Yes sir, it would.

Q. You produced in answer to a question a report; I wish you would look at this pamphlet, which I now hand you, and tell me whether that is a duplicate of the report that you produced upon being asked with regard to certain reports on your cross examination?

A. Yes sir.

Mr. Riker: I offer that in evidence and ask that it be marked. It is a special report of the Passaic Valley Sewerage Commissioners, to the Governor of the State of New Jersey, submitted June 8, 1903.

The Commissioner: Let it be marked.

(Marked Defendants' Exhibit No. 1.)

Recross-examination by Dr. O'Sullivan:

Q. What is the present dilution in the Passaic River for the sewage and trade wastes discharged into it, what is the ratio of dilution?

A. I cannot say, I do not remember.

3541 Q. Can you approximate it?

A. No sir.

Q. So that your answer on that question was a guess, was it?

A. I do not remember guessing at anything.

Q. If you do not know the ratio of dilution how can you answer the question on the present dilution of the sewage and trade wastes discharged into the Passaic River?

A. May I ask which question you refer to and hear it read? I

think I understood the questions before I answered them and I certainly do not remember doing any guessing.

Q. Do you or do you not know the ratio of pollution now in the Passaic River for the sewage and trade wastes discharged into it?

A. No, sir, I do not.

Q. Do you know anything about the tidal phenomena in the Passaic River?

A. No sir. I have known it but there have been so many matters since that I cannot recall the conditions.

Q. Have any float observations made on the Passaic River ever been submitted to you?

A. No sir.

Q. To what do you now attribute the septic condition of the Passaic River?

A. To the sewage discharged into it and the time it remains in the river.

Q. How long does it remain in the river before entering Newark Bay?

A. I do not know.

Q. Have you any general idea or approximate idea?

A. No sir.

Q. In considering the question of dilution by a body of water into which sewage is proposed to be discharged, do you take into the consideration the present polluted condition of that body of
3542 water in order to determine whether or not you would get the measure of dilution that you think would be desirable?

A. You refer to the pollution from New York City as well as the Passaic Valley?

Q. Yes, I am dealing with the body of water itself, no matter where the pollution comes from, into which you contemplate discharging a large volume of additional sewage.

A. Yes sir, I think of that, and yet believe that the treatment given this sewage would produce the results stated in the stipulation.

Q. What is the condition of New York upper bay now with regard to pollution?

A. That I testified to before as being not a desirable condition but a far better condition than most streams into which sewage is emptied, particularly in such quantities.

Q. How long does it take sewage to leave New York Bay that has been discharged into it, and go through the narrows?

A. I have not the records of that, I could not say.

Q. Your observations of New York's upper bay, as I gather from your testimony, were confined to your visual inspections from the decks of the Fall River steamers, is that right?

A. No sir, that is not quite right; the visual part is right, and the additional part would also be right, but not as confined to Fall River steamers, for I very seldom take those steamers. I have been up the Hudson River to Albany many times; I have been across it in ferries many times, and have been through the river in the Providence line of steamers many times, and I have been to Coney Island and thereabouts, and noticed conditions.

Q. But your observations were made from these steamers you have mentioned?

3543 A. Yes sir.

Q. You have never made any attempt to determine the oxygen contents.

A. No sir.

Q. Nor made any other examinations than you have described, the visual and the olfactory?

A. No sir.

Q. I did not quite catch what you said about the ten per cent of the trade wastes; were they to remove ten per cent, or all but ten per cent, which was it?

Mr. Riker: The question was removing all but ten per cent, Doctor.

Q. How is that ninety per cent to be removed?

A. That was not stated to me. The question was asked me—if it was so and so, then what; and it was not told me how that was to be removed.

Q. Do you understand whether or not the trade wastes are to be taken in this trunk sewer

A. I understand more or less of them are.

Q. Approximately how much?

A. I cannot tell you.

Q. Would you say ninety per cent?

A. I would not say for I do not know, I would not express an opinion.

Q. Any data submitted to you did not convey to you the idea of how much of these trade wastes were to be transported in the Passaic Valley trunk sewer project?

A. I got an impression that a large proportion would be conveyed; I cannot say that impression was gained from absolute figures.

Q. And that was approximately ninety per cent?

3544 A. I did not formulate any opinion as to the exact percentage.

Q. Do you know what the flow is in the Passaic River?

A. No sir.

Q. Just one question about defendant's exhibit No. 1; did you contribute any of the material that is contained in that special report of the Passaic Valley Sewerage Commissioners, known in this case as defendants' exhibit No. 1, and dated June 8, 1903?

A. In the Commissioners' Report you say?

Q. In this exhibit.

A. Yes, sir, but what about it?

Q. I ask you if you contributed any of the material for it?

A. I do not think I did.

Further redirect examination by Mr. Riker:

Q. I want to ask you one other question with reference to these results which are stipulated for in complainant's exhibit No. 135,

being the agreement between the United States and the Passaic Valley Sewerage Commissioners and the State of New Jersey; in your judgment will there or will there not be created a nuisance in New York Harbor?

A. I think there will not, I do not see how there can be.

Further recross-examination by Dr. O'Sullivan:

Q. I understood you to say that the effluent as it reached the outfall pipes would be more septic than when it left the disposal works; how do you account for sewage that is septic not causing a nuisance?

A. My answer was it might be slightly more septic.

Q. Would septic sewage discharge sulphurated hydrogen?

A. I think there might be a trace of it.

Q. What do you mean by a trace?

3545 A. Nothing that would be objectionable.

Q. How would you detect a trace, you yourself?

A. I would go down there and smell of it.

Q. There is no chemical method that you could determine it by?

A. I could not myself, I do not say there is no method.

Q. The evidence that you mentioned a little earlier, that you had read, given by Professor Mason and Professor Sedgwick and Mr. Eddy, and the other gentlemen you have mentioned, did you read that they had found there would be a nuisance created?

Mr. Riker: Objected to on the ground that their evidence speaks for itself, and is in the case, and that this witness's knowledge of it is not competent.

The Commissioner: Note the objection of counsel for the defendants.

Dr. O'Sullivan: Complainant's counsel presses the question for the reason that it tests the memory of this witness.

A. As I remember their evidence they thought there would.

Q. Do you recall that they expressed an opinion that there would?

Mr. Riker: I enter the same objection as before.

The Commissioner: Note the objection of defendants' counsel.

A. I do not recall they positively expressed an opinion that such was the fact.

Q. Is colloidal matter putrescible?

A. I do not know, I am not a chemist.

Q. Is there any provision for removing colloidal matter in complainant's exhibit No. 135?

3546 A. Only what is there stated in regard to the treatment of it, that might remove it.

Q. Do you know whether or not colloidal matter is highly putrescible?

A. No sir.

GEORGE S. GREENE, JR., a witness produced on the part of the defendants, being duly sworn by the commissioner, testified as follows:

Direct examination by Mr. Riker:

Q. Where do you live?

A. New York City.

Q. What is your profession?

A. Civil Engineer.

Q. How long have you been practicing that profession?

A. About fifty years.

Q. What education or experience have you had in your experience?

A. After I finished high school education I went to Harvard for a while, but I did not graduate. I left before graduation, and studied civil engineering in the office, and under the direction of my father.

Q. Who was he?

A. General George S. Greene.

Q. Are you connected with any scientific societies?

A. I am a member and past vice president, of the American Society of Civil Engineers, and an honorary member of the Institute of American Architect.

Q. Give some of the work you have been engaged in in your profession since you have been practicing it.

A. I was for a number of years an assistant engineer in the Croton Water Works department, and then for a time, for 3547 a few years, I had an office of my own for general work, and also was making extensive surveys under contract in the annexed district. In 1875 I was appointed engineer in chief of the Department of Docks in New York City, which position I held until January 1898. Since then I have had an office for general work and have done work as a consulting engineer, and also some expert work in the valuation of water front property. At present I am engaged as a consulting engineer.

Q. What opportunities for the observation of harbors have you had?

A. As engineer in chief of the Department of Docks our water front, the water in it as well as the structures, were under my charge and supervision constantly, and I observed the condition of the water at various points with regard to the surface of the harbor.

Q. Have you had any special training in chemistry?

A. No sir.

Q. In bacteriology?

A. No sir.

Q. Will you give such observations as you have made of the character of the waters in New York harbor.

A. My observations were in the slips and out in the current, in the main channel, in the fairway, frequently, not to say constantly, and to observe, and when I could correct, the discharge of improper material, sewage matter for instance, into the waters of the harbor. That is, when the sewers ended at the bulkhead, the boundary line

between the land and the water, sewage, fecal matter, and other matters, from the sewers, would collect; but as we went along making improvements to the water front, we would carry the sewers out to the ends of the piers, where they would discharge into more cases, there was very little to be seen of the results of the discharge of the sewers.

Q. What acquaintance have you had with the project of the Passaic Valley Sewerage Commissioners, and when did you make that acquaintance?

A. In 1902 or '03 I was asked to read Mr. Herring's report, and asked if I thought his proposition—what he proposed to do—would be any detriment or create any nuisance in the harbor of New York. I did so, read Mr. Herring's report, looked up some points of information and made a report.

Q. Do you know whether that report is embraced in the pamphlet which is defendants' exhibit No. 1?

A. Yes sir, it is.

Q. The report of Mr. Herring, upon which you made your report, have you that with you?

A. Yes sir.

Q. Did the proposal upon which you made your report, which is embodied in defendants' exhibit No. 1, involve any purification of the sewage of the Passaic Valley sewer?

A. Yes sir.

Q. What purification was contemplated at that time?

A. It was to be screened and allowed to settle, those are the principal things; they were to put up some sort of skimmers also to take any floating matter that would be on the surface of the sewage passing through the sedimentation boxes or tanks.

Q. Where was the point of discharge contemplated, upon which you based your report?

A. At the same place as at present, that is near Robbins Reef Light, in a depth of forty feet of water.

Q. And through one outlet or through multiple outlets?

A. I think it was several.

3549 Q. Have you read the stipulation which is complainants' exhibit No. 135, a stipulation between the United States Government and the State of New Jersey and the Passaic Valley Sewerage Commissioners?

A. Yes sir.

Q. I hand you the original exhibit and ask you to look at it and see if you are familiar with the contents of the stipulation.

A. (After examining Exhibit No. 135.) Yes sir.

Q. In your opinion will the discharge from the Passaic Valley sewer, subjected to the purification processes described in that stipulation, and discharged as described in the stipulation, produce the results in the waters of New York Bay which are contained in that stipulation?

A. I think so, yes sir.

Q. And if those results are obtained or appear from the sewage

discharged as described and treated as described, will there in your judgment be created any nuisance in New York Bay?

A. No sir.

Q. Do you base your answer upon chemical considerations?

A. No sir.

Q. Do you base it upon bacteriological considerations?

A. No sir.

Q. What do you base your answer upon?

A. Dilution.

Q. What knowledge have you of the dilution capacity of Upper New York Bay?

A. My answer would be largely figures which I cannot carry in my mind. Is it permissible for me to read them?

Q. Certainly, sir, refresh your memory from whatever will refresh it.

Dr. O'Sullivan: One moment, what are you consulting now?

Witness: A copy of my report made in 1903.

3550 Dr. O'Sullivan: Which is in evidence here in defendants' exhibit No. 1?

Witness: I think so, yes sir.

Dr. O'Sullivan: At what page?

Witness: I am looking now at page 8.

From the United States Coast Survey Report of 1896 I obtained the following:

Tidal Flow New York Harbor.

Epitome of Results for Discharge 25th June, 1886.

East River (19th Street):

	Cubic feet.
Ebb (westerly)	4,454,937,257
Flood (easterly)	4,007,175,676
Excess of ebb.....	447,761,581

Hudson River (39th Street):

	Cubic feet.
Ebb (southerly)	6,996,678,413
Flood (northerly)	6,225,985,545
Excess of ebb.....	770,692,868

Kill von Kull (West New Brighton):

Ebb	1,790,103,372
Flood	1,712,415,362
Excess of Ebb towards the harbor.....	77,688,010

Narrows:

Ebb (seaward)	13,819,895,144
Flood	12,703,616,481
Excess of Ebb.....	1,116,278,663

I also take the following from the same report.

	Cubic feet.
Fresh water discharge of Hudson at 39th Street Aug. 11, and 12, 1865.....	385,346,424
Fresh water discharge of Hudson at Dobbs Ferry Aug. 19 and 21, 1865.....	373,426,507

That is the data I had.

3551 Q. Have you a basis of determination of the safety of discharge of sewage into water based upon dilution?

A. No sir.

Q. What did you calculate as a safe basis?

A. I do not calculate, I have not at least calculated what is a safe basis, but when I find there is a certain basis a small one, I consider that that is perfectly safe.

Q. Taking the diluting power of New York Bay as you have determined it from the figures which you have examined what, in your opinion, will be the effect of the discharge of an effluent or a sewage discharge, treated as specified in this stipulation, into the waters of upper New York Bay?

A. I think it will be hardly perceptible, to the senses I mean, such as smell or sight.

Q. Do you think there will be an absence in New York Bay of visible suspended particles coming from the Passaic Valley Sewage?

A. I think so.

Q. Do you think that there will be an absence of deposit which should be objectionable to the Secretary of War of the United States, in New York Bay, coming from the Passaic Valley Sewage?

Dr. O'Sullivan: Objected to as clearly beyond the purview of this witness's knowledge.

The Commissioner: Note the objection of counsel for the complainant.

A. Absence of something coming from the sewers?

Q. Absence of deposits objectionable to the Secretary of War of the United States, in New York Bay, coming from the Passaic Valley Sewage?

A. I think there will be no deposits coming from that sewage that the Secretary of War should object to.

3552 Q. Do you think that there will be absence in the New York Bay and its vicinity of odors due to the putrefaction of organic matter contained in the Passaic Valley sewage?

A. I do.

Q. Do you think there will be a practical absence on the surface

of New York Bay of any grease or color due to the discharge of the Passaic Valley sewage at the dispersion area or elsewhere?

A. I think so.

Q. Do you think that there will be any injury to the public health which will be occasioned by the discharge from the said sewer into the bay of New York in the manner proposed or any public or private nuisance created thereby?

A. No sir.

Q. Do you think there will be absence of injurious effects from said sewage discharge upon the property of the United States in the harbor of New York?

A. Yes sir.

Q. Do you think that there will be an absence of reduction in the dissolved oxygen contents of the waters of New York Bay resulting from the discharge of the Passaic Valley sewage to such an extent as to interfere with major fish life?

A. That I don't know and don't understand.

Q. In case the sewage treated as specified in this stipulation by the works and processes therein particularly described should not result when discharged in New York Bay as is guaranteed in the stipulation, are there other processes which you know of which could be added, and which would be efficient in producing such a result?

A. Well, there is the extreme process of sand filtration which might be resorted to to make the water fit for drinking, as is done in Poughkeepsie and several places? If there are some minor
3553 defects, some small failures to accomplish all these results stipulated, they might be overcome by keeping certain substances out of the sewer.

Q. Directing your thought now to the subject of trade wastes would or would not in your judgment the exclusion of them, at the point of production, so that they did not reach the sewer at all, have the result of increasing the purity or clarity of the effluent?

A. I should think it would yes sir.

Q. What in your judgment will be the result on the waters of upper New York Bay of the discharge of sewage treated as is described in this stipulation, compared with the conditions which result from the discharge of the waters of the Passaic River and Newark Bay into the upper bay as now occurs?

A. I think the raw sewage discharged into Newark Bay is a bad thing and may do a great deal of injury, but purified as is proposed here I do not think the purified discharge will do any harm.

Q. Have you any special knowledge of the subject of trade wastes either as discharged from New York sewers or into the Passaic River?

A. No sir.

Q. Do you have any knowledge, casual or otherwise, of the discharge of trade wastes into New York Bay from the City of New York?

A. No sir.

Cross-examination by Dr. O'Sullivan:

Q. You did not graduate from Harvard, did you, Mr. Greene?

A. No sir.

Q. Did you graduate from any educational institution?

A. The ordinary high school.

Q. And you took no degree in civil engineering?

3554 A. No sir.

Q. And no degree in chemistry?

A. No sir.

Q. And no degree in either bacteriology or biology?

A. No sir.

Q. What year were you a member of the dock department of New York City?

A. 1875. I was not a member of the dock department, I was an employee, engineer in chief if you please, from 1875 to 1898.

Q. I direct your attention to page 4 of defendants' exhibit No. 1.

A. Yes sir.

Q. I refer to the last paragraph and begin at the second sentence where it says "For many years he was a member of the dock department of New York City." Was that correct or not?

A. I was an employee of the dock department, but I was not a member of the Board governing the department, the department of docks consisted of three men, they constituted the board in my notion. I did not write that, and I don't know who did.

Q. Is that correct or incorrect?

A. I have endeavored to explain it, sir, that I was an employee of the department of docks, as engineer in chief, that was my title.

Q. What did you understand in 1875 as the dock department of New York City?

A. The board of the commissioners governing the affairs of the department.

Q. Were you a member of that board?

A. No sir.

3555 Q. So that is a misstatement, is it not, that you were for many years a member of the dock department of New York City?

A. As a member of the board the department, it is a mistake. As an engineer of the department, if that constitutes a membership, in some people's opinion, why it is correct.

Q. Who do you regard it?

A. I consider that I was an employee of the department, sir.

Q. Directing your attention to page 8 of defendants' exhibit No. 1, from which you read the figures that you gave, which you say were taken from the United States Coast Survey in 1886—is that correct?

A. Yes sir.

Q. Do you know whether those figures have since been corrected?

A. I do not.

Q. Taking all the figures that you have given us with regard to the ebb and flow volume, they related to waters above the narrows, is that correct?

A. I read some at the narrows, I think.

Q. Do you know where the cross sections were taken to measure that volume at the narrows?

A. No sir.

Q. What do you understand by the narrows?

A. The stretch between the upper and lower bay between a certain distance on Staten Island and between a certain distance on Long Island.

Q. Do you know the length of the narrows?

A. I do not remember, no.

Q. Do you know the width?

A. No.

Q. Do you know the depth?

A. Approximately one hundred feet or something of that kind.

Q. Do you know where that cross section was taken which 3556 you read as "Narrows," ebb and flood"?

A. No sir.

Q. Do you know whether it was taken on the New York upper bay side of the narrows, or the New York lower bay side of the narrows?

A. No sir.

Q. I ask you if all those cross sections which you read were not taken above the narrows?

A. I do not know sir.

Q. Were those the most favorable sections which you have taken to the argument which you have undertaken to support with them?

A. I do not know whether there are any more favorable locations or cross sections to be taken or not.

Q. Are you sure that you did not embody in your report that those sections were selected as the best. Please answer without consulting your report.

Mr. Riker: No, he can consult the exhibit, you cannot catch him that way.

Q. Can you answer that question without consulting the report?

Mr. Riker: You do not have to.

Q. I ask you if you can.

A. May I have the question repeated.

Q. (Question read as follows: "Are you sure that you did not embody in your report that those locations were selected as the best?")

A. Now you wish to know whether I can answer that question without looking at the book or not?

Q. Yes.

A. No sir, not certainly, I do not recollect exactly.

Q. Do you consider that the waters above the Narrows should be taken into any estimate of lines of dilution for the sewage 3557 proposed to be discharged at Robbins Reef?

A. Water above?

Q. Above the Narrows.

A. Yes, sir.

Q. I direct your attention to the third paragraph on page 9 of defendants' exhibit No. 1:

"As the discharge or outfall of the sewage is to be on the westerly side of the main channel, and as there will be no sufficient force to push the sewage across the current of the channel, it is not proper to consider for localities above the Narrows this total volume of the water passing in and out of the upper harbor, as that available for diluting or dissipating the sewage."

Do you recall having embodied that as part of the report you made?

A. Yes, sir.

Q. And it was correct, based upon the premises that you were making your report on, was it?

A. Yes sir.

Q. Do you regard sewage as lighter or heavier than the water it would be discharged into in New York Bay?

A. It may be or it may not be.

Q. Do you recall what opinion you expressed on that in your report of 1903?

A. Yes.

Q. Which did you conclude it was then?

A. Lighter.

Q. Do you still regard it as lighter?

A. As a general proposition, yes, but it may carry some salt or something in solution, mechanical solution in it, which will make it not so; but as a general proposition I adhere to what I said then.

Q. Do you recall then describing the sewage which was 3558 contemplated to be brought in the Passaic Valley trunk sewer?

A. Yes sir.

Q. Has its character changed in your estimation since 1903?

A. I think it is probably more purified as now proposed than it was then.

Q. Would that make it lighter or heavier?

A. It would probably make it lighter, but possibly, through carrying something in solution, it might make it heavier.

Q. What do you contemplate it would be likely to carry in solution that would make it heavier?

A. Some organic matter that is heavy might be there.

Q. I call your attention, Mr. Greene, to the last line of page 10, of defendants' exhibit No. 1, and the succeeding lines forming that paragraph:

"In addition to simple dilution by discharge into the large volume of current, I consider the plan of discharging the sewage at a depth of forty feet below the surface, of value, because the sewage being fresh water and lighter than salt water has a tendency to rise, and in rising it will spread and be diffused, thereby increasing the dilution and dissipation of the sewage."

Q. Do you recall embodying that in your report?

A. Yes sir.

Q. Do you now think that the sewage which you then described as

likely to rise would be so heavy in the present instance as not likely to rise?

A. No sir.

Q. Are your estimates for dilution entirely based on the Coast Survey Report for 1886?

A. Yes, sir.

Q. Do you know what the tidal prism in New York Harbor is now?

A. The tidal prism in New York Harbor is the difference between high and low water mark bounded by the borders of the Harbor.

Q. What is its volume in cubic feet or cubic yards?

A. I do not recollect.

Q. Have you yourself ever made any effort to determine what the volume of the tidal prism in New York upper bay is?

A. I think so, but I do not recollect it.

Q. If this sewage which you have described here as light and with a strong tendency to rise, rises to the surface, would it not be visible?

A. If it was not diluted before it got there so that it would not be noticed by the senses it might be visible.

Q. How deep down is the under run?

A. I do not know.

Q. Do you know anything about the phenomena of the under-run in upper New York Bay?

A. Very little.

Q. How do you know this sewage would rise or be carried by the under run?

A. It is a matter of opinion.

Q. Is it a matter of opinion whether there is an under run or not in New York upper bay?

A. I think that has been proved.

Q. What do you understand by the under run?

A. The movement of the salt water underneath the surface water which is brackish or lighter.

Q. How deep is the channel at that point, at Robbins Reef?

A. About seventy feet.

Q. How high up does the under run come?

A. I do not know.

Q. So that the under current would take matters discharged into it north while the ebb was going south, is not that a fact?

A. I think so.

3560 Q. Do you know whether it is or not?

A. I do not know.

Q. So that this sewage discharged into the under run would be taken in the region of the Hudson or East River either on an ebb or flood tide, would it not?

A. It might.

Q. When were you retained in this case?

A. This one here now?

Q. For the testimony you have given now?

A. I think about the latter part of December, the 28th or something like that.

Q. Six or seven weeks ago?

A. I think so.

Q. Have you made any tour of inspection of New York Harbor's water since then.

A. No sir.

Q. Have you made an inspection of New York Harbor waters since your connection with the Dock Department?

A. Oh, yes.

Q. When?

A. At the time I made this report I looked about a good deal.

Q. Since 1903?

A. Nothing direct and special since 1903.

Q. You mentioned Mr. Herring's report in 1903; Mr. Herring was the parent of this trunk sewer scheme, was he not?

A. I think so.

Q. Do you know what his present attitude is toward the feasibility and efficiency of that trunk sewer project?

Mr. Riker: Objected to on the ground that it is immaterial, irrelevant and impertinent.

The Commissioner: Note the objection of counsel for the defendants.

A. I do not.

3561 Q. In determining questions of dilution do you take into consideration the question of whether or not the water that is to act as the diluent is already heavily polluted or not?

A. Yes sir.

Q. Did you take that into consideration in New York Bay in 1903?

A. Yes sir.

Q. How does New York's upper bay present condition as to pollution, compared with the condition that it was in in 1903?

A. I do not know that it has changed substantially.

Q. How much has New York City increased in population since 1903?

A. I do not know.

Q. Do sewage discharges bear any relation to increase in population?

A. Probably yes, I suppose so.

Q. Can you state more affirmatively, one way or the other?

A. Why I think so, decidedly.

Q. Would it surprise you if New York's upper bay was in a similar condition to what it was in 1903 and yet the population has increased over four hundred thousand?

A. If you are going to make a chemical analysis I would expect there would be some difference; if you simply depend on the ordinary sense of sight and smell I doubt if there is any.

Q. Have you known of any oxygen determinations for the upper bay?

A. No sir.

Q. Do you regard oxygen as a fair measure of the condition of the water as to pollution, or the absence of pollution?

A. Do I?

Q. Yes.

A. No sir.

Q. It would not have any influence on your opinion
3562 whether it had a large or small oxygen content?

A. It might do something of that kind.

Q. Would it materially do it?

A. It might materially, on more information than I have in regard to the function or value of oxygen in the water. As I understand it water will receive but a small amount of oxygen over and above what it naturally has.

Q. What would you place that amount at?

A. I cannot tell you, I am not a chemist.

Q. Five per cent?

A. I would not hazard anything.

Q. Three per cent?

Mr. Riker: He said he would not hazard anything.

Q. Can you give me an approximation?

A. No, sir.

Q. How would you determine whether water was or was not polluted?

A. By inspection.

Q. Simply by the *aleofactory* sense and the sense of sight?

A. Yes, that is all.

Q. Is it possible or probable in your opinion for water to be highly polluted and yet not give off offensive odor?

A. I think it is possible, yes.

Q. In that case how would you determine the presence or absence of pollution?

A. By chemical analysis.

Q. Have you ever conducted any chemical analyses?

A. No, sir. I mean not personally.

Q. What would the chemical analyses be directed towards determining, what fact or condition or element?

A. It might be for some substance carried in solution, or it might be for germs, or something of that kind.

Q. Have you ever seen the effluent from an Imhoff tank?

3563 A. No, sir.

Q. Have you ever seen the effluent from a septic tank?

A. No, sir.

Q. Have you ever seen an effluent from any sewage disposal system?

A. Disposal system?

Q. Yes.

A. Not that I recollect.

Q. Have you ever been in charge of disposal works anywhere?

A. No, sir.

Q. Have you ever had any direction or control over sewage disposal works or sewage purification projects or schemes?

A. No, sir.

Q. What do you mean by visible suspended particles?

A. Sometimes in water, in moving water, there are small particles of—I don't know what, possibly water soaked vegetation, wood or timber or something like that; possibly paper.

Q. They would be visible on the surface of the water would they not?

A. Oh yes.

Q. How would you determine whether or not there were visible suspended particles immediately below the surface of the water, say six inches below the surface of the water?

A. If I wished the information I suppose I would dip up the water and look at it.

Q. Have you ever done that in New York Upper bay?

A. Not for a good while.

Q. What do visible suspended particles that have such origin represent, organic or inorganic matter?

A. I think they represent organic matter.

Q. And highly putrescible?

A. Perhaps.

Q. You said, relative to the deposits, as I understood it, 3564 that you would not expect those deposits to be substantial; did I get that right?

A. Substantial, or of substantial value.

Q. I want to be a little more definite on that if I can; what would you consider a substantial deposit, or a deposit of substantial value?

A. One that decreases the depth of water, one that made on the bottom of the bay and decreased the depth of the water to some extent, some substantial value or extent.

Q. To what extent would you expect deposits from a sewage effluent whose results are guaranteed in complainant's exhibit No. 135, just a rough approximate.

A. If that discharge carried with it but one-thousandths part of the total quantity discharged of mineral material that would settle on the bottom eventually, it would make a layer about one-thousandth of an inch thick, or three hundred and sixty-five one thousandths of a foot per year. That I do not think would be objectionable to the Secretary of War.

Q. Did you read General Roberts' testimony given in this case?

A. No sir. Oh, I don't know but what I did, I beg pardon, I think I did.

Q. Did you follow his line of computation for the amount of sedimental and deposited matter.

A. Not that I recollect.

Q. What percentage of organic matter in sewage do you regard as sedimentable?

A. As what?

Q. Sedimental, capable of being deposited?

A. I have not made any estimate of it, I have not any definite idea.

Q. The estimate that you did give related to the inorganic matter did it not?

2565 A. Yes, mineral.

Q. Do you think that amount of organic matter would equal in volume the inorganic?

A. That is the general report of works, books on the contents of American sewage.

Q. Do you regard the sewage contemplated to be carried in the Passaic Valley trunk sewer as unusually rich in trade waste?

A. I have not so considered it, no.

Q. What percentage would be trade waste?

A. I do not know.

Q. Do you recognize that the Passaic Valley has a very large number of factories?

A. I have heard so.

Q. Do you know whether there are many there or not, of your own knowledge?

A. No, I do not.

Q. Do you know what the character of any of those trade wastes that would be taken by the Passaic Valley trunk sewer, as to their organic contents, is?

A. Not as to absolute knowledge, only hearsay.

Q. Do you know if some of those trade wastes are rich in coloring matter?

A. I suppose so, but I have no absolute knowledge of any trade wastes.

Q. Do you recognize a color form of nuisance, a color nuisance; can color be so objectionable in other words as to become a nuisance?

A. On the surface of the water?

Q. Yes.

A. I should hardly think so.

Q. Have you ever seen the sleek fields in Boston Harbor?

A. Not that I recollect.

2566 Q. Have you ever seen the tar coverings of some of our bodies of water from gas works?

A. Some, yes sir.

Q. Do you regard those as a color nuisance?

A. I do not think they are a nuisance; they did not strike me as objectionable as far as their color was concerned.

Q. Is there any provision in complainants' exhibit No. 135 to remove the coloring matters from these various wastes that are contemplated to be discharged at Robbins Reef?

A. I think there is incidentally, but not mentioned directly.

Q. Is coloring matter sedimentable?

A. It may be.

Q. For instance, what coloring matters are sedimentable that you know of?

A. Indigo.

- Q. Will indigo precipitate?
A. Sometimes.
Q. And leave any color behind?
A. Not wholly, it leaves some generally.
Q. What other coloring matters are sedimentable?
A. I do not think of any other, I do not recall any other.
Q. Are colloidal matters larger in volume in septic sewage than in fresh sewage?
A. Is what?
Q. Colloidal matters?
A. Oh, I don't know, I don't know, sir.
Q. Do you know what colloidal matters are?
A. Yes sir.
Q. What are they?
A. Oh something like a jelly,—jelly form.
Q. Is that your best description of colloidal matters?
A. Yes sir.
Q. How does a colloidal matter in suspension differ from
3567 a true solution?
A. I don't know.
Q. Which is the more putrescible?
A. I don't know.
Q. Which will consume the larger amount of oxygen from the waters into which they are discharged?
A. I don't know.
Q. Do you know of any provision made in the stipulation for the removal of either organic matters in solution or colloidal matters?
A. I think that when it passes through these tanks full of stone both those matters would be collected, taken from the water; but I have not any accurate knowledge in regard to sewage treatment.
Q. Does screening remove organic matter in solution?
A. Screens?
Q. Screens.
A. They might.
Q. Organic matter in solution?
A. Oh, in solution? No, I suppose not.
Q. Will sedimentation remove organic matter in solution?
A. I think so, but I don't know.
Q. How would you sediment organic matter in solution, how would you deposit it?
A. Let it stand in still water.
Q. And it will deposit?
A. I think so, if it is heavier than water, not otherwise.
Q. Do you believe that pathogenic germs can live for any definite time in sewage?
A. I have not any definite information in regard to pathogenic germs.
Q. Do you know whether or not tubercle bacilli will live for over ten months in putrefying sewage?
3568 A. No sir, I do not.
Q. Do you know how long the bacillus typhosus will live in sewage?

A. I do not.

Q. Is there any provision in complainants' exhibit No. 135 for the removal of these disease bearing germs?

A. I do not know of anything specific, but in general I think there would be some removal of them.

Q. Would it be appreciable in your estimation?

A. I do not know.

Q. What do you mean, Mr. Greene, by exclusion of trade wastes at factories?

A. There are certain substances that ought not to go into the sewer, for instance, what I had in mind was that a brewer at one time poured all his grains into the sewers and as the engineer in chief of the dock department I had to go and dredge them out of the harbor and protest against his being allowed to do it any more, putting them into the sewer.

Q. What provision is there to prevent brewers along the Passaic water shed from discharging their grains into the trunk sewer?

A. I don't know.

Q. There is none as far as you know?

A. I don't know anything about that.

Q. Have you examined the plans and specifications of the Passaic Valley Sewerage Commissioners?

A. No sir.

Q. I did not quite catch what you meant by tanks of stones—I caught the words in reply to some question put to you by Mr. Riker, some matter you alluded to in relation to tanks full of stones, or something like that; that is how I caught it.

A. It shall pass through screens to remove all floating matter "and after passing through such coarse screens shall pass 3569 through a grit basin or basins where the heavy matter therein shall be taken out as far as practicable." I do not exactly know what size they mean here, but I have heard, in some places, of a tank being filled with broken stones and the sewage passed through it, because certain of the matter contained in the sewage adhered to the stones which were afterwards taken out and washed.

Q. And you regarded that, did you not, as a good provision?

A. I think it was, in the account that I read of it, it was commended.

Q. And you find no such provision for the disposal of sewage in the Passaic Valley sewerage process?

A. Not definitely, no sir, not specifically.

Q. Have you studied the sewage disposal scheme for the Newark meadows contemplated by the Passaic Valley Sewerage Commissioners?

Mr. Riker: I did not know there was any for the Newark meadows.

The question is objected to on the ground that it does not appear in the evidence there is any scheme for the sewage of the Newark meadows.

The Commissioner: Note the objection of counsel for the defendants.

A. If I understand your question, sir, I have not.

Q. Where has it been described to you that these sewage disposal works were to be erected?

A. In this stipulation?

Q. Yes, in complainants' exhibit No. 135?

A. In this—I don't know what you call this.

Mr. Riker: That is supposed to be a copy of complainants' exhibit No. 135.

Witness: In complainants' exhibit No. 135?

Q. Yes.

A. Do you wish me to quote that?

3570 Q. I do not think you understood my question.

(Former question read to witness as follows: "Where has it been described to you that these sewage disposal works are to be erected?")

A. At a point at or near the pumping station to be located on the Newark meadows near the Newark Bay.

Q. And the effluent that would be produced through the operation of these disposal works, how was that to be conveyed to New York upper bay?

A. By pipes, pumping.

Q. Did you get a description or did you see plans of those pipes?

A. No sir, I did not see any plans of them, I think some description gave the size of them, that I read some time or other.

Q. Do you know the material that the pipes were to be made of?

A. I think they were to be made of iron or steel, steel I think.

Q. Was it described to you how low, with reference to the waters in Newark Bay, those pipes were to travel?

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendants.

A. Not that I recollect.

Q. I understood you to say that this effluent would not cause any material injury to Newark Bay if discharged into it, am I right.

Mr. Riker: He never said so.

Dr. O'Sullivan: I asked him if he said so.

Witness: No sir, I never said any such thing.

Mr. Riker: I do not think it is fair for counsel to put into the witness' mouth things that he knows he did not say. That
3571 is my objection to the question.

Dr. O'Sullivan: He said it and the record will show he said it.

The Commissioner: Note the objection of counsel for the defendants.

Q. Would this effluent injure the waters of Newark Bay?

A. I have made no study of Newark Bay and know nothing in detail about it, and therefore cannot answer your question.

Q. Can you recall any question being put to you by Mr. Riker as to what influence that effluent would exert if discharged into Newark Bay?

A. Yes, sir, but if you please, I understood that to be the sewage as now discharged, which goes down through Newark Bay and out into the Kill von Kull; not anything that you call an effluent from these works.

Q. Would that effluent differ in any particular no matter where it was discharged; would the point of discharge influence the character of the effluent?

Mr. Riker: The question is objected to as immaterial, incompetent and irrelevant and answering itself.

The Commissioner: Note the objection of counsel for the defendants.

A. I suppose that the character of the effluent as you call it would be the same, but it might be changed very much by the place, the locality, where it was discharged.

Q. The effluent whose results are guaranteed or stipulated for in complainants' exhibit No. 135, how would that be influenced, changed or altered by discharge either in New York Bay or in Newark Bay?

Mr. Riker: The question is objected to on the ground that the effluent is not described in the stipulation, but it is guaranteed that a discharge into New York Bay of the Passaic Valley sewage 3572 will produce certain results there.

The Commissioner: Note the objection of counsel for the defendants.

A. In Newark Bay I do not know, because I do not know Newark Bay and have not studied it; in New York Bay there is a large volume of water into which it would be discharged, which would dilute it.

Q. How does this volume of water in Newark Bay compare with the volume of water in New York Bay?

A. I do not know, sir.

Q. Does the character of water in Newark Bay, either as to its salinity or otherwise, differ from the water in New York upper bay?

A. I do not know sir.

Q. Then what features, or factors, in the waters of Newark Bay would you need to know of in order to determine whether or not the effluent would be different if discharged into that body of water from what it would be if discharged into New York upper bay?

A. One of them would be the volume.

Q. The volume of what?

A. Of water in Newark Bay passing by the point of discharge of the sewage.

Q. If this effluent in its guaranteed results will have no visible

suspended particles, or the other matters stipulated for, of what effect would greater dilution be?

Mr. Riker: Objected to on the ground that there is no effluent guaranteed or provided for, but that the only discharge spoken of is as being the discharge from the Passaic Valley sewer into New York Bay.

The Commissioner: Note the objection of counsel for the defendants.

A. I do not know whether I understand that question. If
3573 it did have some floating particles before it was diluted, there might be so many of them—so dense—that they could be seen, but in dilution they would be so separated they would not be seen, it would be too diluted, in case it were there.

Q. Any other effect?

Q. What percentage of matter would be removed from the sewage carried in the trunk sewer project, by the sewage disposal works contemplated in complainants' exhibit No. 135?

A. I don't know.

Q. What percentage of solid or organic or inorganic matter would be carried in the effluent discharged from the sewage disposal works?

A. I don't know sir.

Q. How do you know then that the matters discharged from the sewage disposal works would need dilution?

A. I assume that they do need dilution, that dilution is advisable because the discharge from the sewer is not absolutely pure, or not as pure as it can be made by dilution.

Q. How does dilution purify a septic effluent.

A. In the same way that it would not be so strong if mixed with a larger amount of fluid.

Q. And that is the only benefit you would get from dilution?

A. Yes, the only one I think of.

Q. Have you ever crossed Newark Bay in any form of craft on the water?

A. Not that I recollect.

Q. Can you tell me where the most advantageous place in Newark Bay would be for the discharge of an effluent from the sewage disposal works described in complainants' exhibit No. 135?

Mr. Riker: The question is objected to as irrelevant, immaterial and impertinent.

The Commissioner: Note the objection of counsel for the
3574 defendants.

A. No sir.

Q. Have you read the testimony of any of the gentlemen described by Mr. Gray in his testimony, who offered their evidence in this case?

A. I do not recollect reading the testimony of anybody in this case excepting General Roberts, I think he is the only one.

Q. What data was submitted to you before asking your opinion today in regard to this litigation.

A. Data? I did not have data, that I would call data. Perhaps I do not understand your meaning of that term.

Q. Did you read any other testimony given in the case except that of General Roberts?

A. Not that I know of.

Q. Did you examine the plans and specifications of the Passaic Valley Sewerage Commissioners?

A. No sir.

Q. For this trunk sewer?

A. No sir.

Q. Did you read any of the reports of the Passaic Valley Sewerage Commissioners other than the one which has been offered in evidence here.

A. Mr. Herring's report I read, if that is what you mean.

Q. And that is included in defendants' exhibit No. 1, is it not?

A. I think not, Mr. Herring's report has not, so far as I know been marked as an exhibit yet.

Q. What report do you refer to now?

A. The annual report of the Passaic Valley Sewerage Commissioners to the Legislature, Session of 1903, on page 21 of that begins a report of Mr. Herring—I think his first name is Rudolph, but I am not clear about that—yes, Rudolph Herring, that is right.

3575 Q. Have you read any other report besides the report of Mr. Herring in 1903, and the report to which you contributed material and which is now in evidence as defendants' exhibit No. 1?

A. Not that I recollect, now.

Q. So that the facts, plans, reports and other matters, with the exception of General Roberts' testimony, have all been before 1903, that you have consulted and read, is that right?

A. Yes sir.

Q. How was that effluent to be sent to New York upper bay from the sewage disposal works on the Newark meadows?

A. How was it to be sent?

Q. Yes.

A. Pumped, I understood.

Q. And pumped after the sedimentation and screening and other processes that you have described?

A. Yes sir, I understand so.

Q. Have you made any inspection of the Passaic River within the seven weeks or so since you have been retained in this case?

A. No sir.

Q. Nor of Newark Bay?

A. No sir.

Q. Nor of New York upper bay?

A. No sir, nothing special.

Redirect examination by Mr. Riker:

Q. You have had before you the substance of, or a duplicate of complainants' exhibit No. 135? Have you?

A. Yes sir.

Q. And you were asked to testify on the results of a discharge of sewage producing the guaranteed results?

A. Yes sir.

Q. If you were going to determine whether there were visible suspended particles in water would you do it in any other way than by looking at it?

3576 A. No, I think not.

Q. So that the only way you can tell whether those things are visible or not is by looking at them?

A. I think so.

Q. You testified that as to water you would determine its purity by the senses and not by chemical examination. Did you intend that to apply to potable water or to waters of the harbor?

A. Oh, to waters of a harbor.

Q. If you were trying to determine whether water was fit to drink or not would you get at that in some other way?

A. Some other way, yes sir.

Q. Are the waters of New York Bay potable waters or are they not in your judgment?

A. They are not in my judgment.

Recross-examination by Dr. O'Sullivan:

Q. Can they be made potable?

A. Potable water can be made from them, sir by distillation.

Q. Would it be advisable to add to the sewage disposal scheme those stones that you described in a tank?

A. I don't know, sir, I don't know enough about sewage disposal or purification to say whether it would or not.

Q. You have never had any direct experience in sewage purification?

A. No sir; I referred to that because I had seen it recommended in some writing.

Q. Have you made any calculation to determine how much the tax payers of the Passaic Valley would be saved if the sewage was discharged into Newark Bay instead of into New York upper bay?

Mr. Riker: Objected to as immaterial, irrelevant and impertinent.

The Commissioner: Note the objection of counsel for the defendants.

3577 A. No sir.

By Mr. Riker:

Q. You made an estimate of the deposit of solid matter on the floor of New York Bay upon a certain assumption, did you not?

A. Yes sir.

Q. Did you make any estimate of the amount that would actually be deposited from the discharge from the Passaic Valley sewer?

Dr. O'Sullivan: Objected to as incompetent.

The Commissioner: Note the objection of counsel for the complainant.

A. No sir, I made that on that assumption only.

By Dr. O'Sullivan:

Q. Is the reason for not making an actual computation that there is no actual discharge of sewage now at Robbins Reef from the Passaic Valley sewer?

A. Oh, no sir. The reason is because I have no other sufficient data. The point that I knew of, one one-thousandth of solid matter from sewage, is derived from an estimate of people who are considered experts, and I assumed that it was correct and used it in that way.

Q. And that referred to inorganic matter?

A. Yes sir, mineral.

Q. And you made no computation of the deposits from organic matter?

A. No sir.

Q. Nor from colloidal matter?

A. No sir.

The further taking of testimony on the part of the defendants was adjourned to Thursday, February 13th, 1913, at the office of Messrs. Riker & Riker, Newark, N. J.

3578 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,

vs.

THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Taking of Testimony at the Office of Messrs. Riker and Riker, Newark, N. J., Thursday, February 13th, 1913.

Before James D. Maher, Esq., Commissioner.

Appearances:

Thomas Carmody, Esquire, Attorney General of the State of New York;

William A. McQuaid, Esq., Deputy Attorney General;

Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants;

Edmund Wilson, Esq., Attorney General of the State of New Jersey;

Robert H. McCarter, Esq., of counsel for the State of New Jersey;

Adrian Riker, Esq., of counsel for the Passaic Valley Sewerage Commissioners, Defendants.

GEORGE A. JOHNSON, a witness on behalf of defendants, being duly sworn by the Commissioner testified as follows:

3579 Direct examination by Mr. Riker:

Q. Where do you live?

A. Montclair, N. J.

Q. What is your profession?

A. I am a consulting engineer and a sanitary expert.

Q. How long have you been engaged in that profession?

A. For the past 17 years I have been engaged on matters relating to the purification of water and the disposal of sewage.

Q. Where have you been practicing your profession?

A. My experience in this line of work began in 1895 at Louisville, Kentucky, where I was a member of the staff of the Louisville Water Company which was at that time making investigations into the feasibility of purifying the Ohio River water by mechanical filtration. At that place I occupied successively the positions of inspector and assistant bacteriologist. On leaving Louisville I became assistant bacteriologist to the Commissioners of Water Works of Cincinnati, Ohio, where similar studies were inaugurated in the early part of 1899. Leaving Cincinnati I took up work in connection with the filtration of water at York, Pennsylvania, Norfolk, Virginia and elsewhere. I then became assistant engineer to George W. Fuller, Consulting Engineer, who had offices at 220 Broadway, New York City. During the year 1900 I was Associate Director of a special city laboratory of the city of St. Louis, making investigations into the effects of the Chicago Drainage Canal upon the water supply of that City. Following that engagement I was engaged at Philadelphia under Mr. Rudolph Herring, Consulting Engineer of New York, on actual studies relating to the filtration of the water supply of Philadelphia.

My next engagement was in charge of the operation of a 3580 mechanical filter plant located at Little Falls, New Jersey.

I then became principal assistant engineer in the department of chemistry and biology of the commission on additional water supply for New York City and during the year 1903 made a sanitary survey of the Hudson River Water Shed. In the years 1904-5 I was engineer in charge of the testing station at Columbus, Ohio, where there were made, under me, exhaustive tests of the various methods of purifying the water supply, and of purifying the sewage, of that city. The results of my investigations at Columbus, were published as a city document in 1905. The year 1906 I spent abroad investigating municipal water supply works in Japan, China, the *Straight Settlements*, Ceylon, India, Egypt, France, Germany and England. Returning I became assistant engineer to Messrs. Herring and Fuller, Consulting Engineers of New York, and in 1908 was made a member of that firm, continuing as such until October, 1910, when I formed a partnership with William B. Fuller, with offices at 150 Nassau Street, New York City. I have been engaged during my professional career on a large number of water supply, sewerage and sewage disposal projects; among others of the last named might be mentioned Columbus, Ohio, Plainfield, New Jersey, Garwood, New Jersey, Chicago, Illinois, Vincennes, Indiana and numerous others. My more important engagements during the past year have been Consulting Engineer to the Bureau of Water Supply of Pittsburgh, Consulting Engineer and a member of the Board of Experts of the Department of Water

Supply, Gas and Electricity of New York City, in connection with the problem of the filtration of the Croton supply; Consulting Engineer to the New York State Conservation Commission, investigating the pollution of shell fish in New York waters.

In addition to these engagements I have designed, or there has been designed under my direction, sewerage works at Glen Cove Long Island, Wildwood, New Jersey and elsewhere, and water purification works for Trenton, New Jersey and elsewhere.

Q. What preliminary education and training did you have before beginning your actual profession?

A. So far as preparing myself technically for the active prosecutions of the profession of Consulting Engineer on water supply, sewerage and sewage disposal, I had none; I have acquired such knowledge as I possess by successively working up through various stages leading to this untimate end.

Q. What special connection have you had with the Passaic Valley Sewage project?

A. In 1907 when I was connected with the firm of Herring and Fuller, that firm was acting as consulting engineers to the Passaic Valley Sewerage Commissioners and to me was given the task of solving the problem of the disposal of the sewage of the district. The design was placed in charge of my present partner, William B. Fuller. I actively prosecuted this investigation during the year 1907, paying particular attention to questions involving the probable composition of the Passaic Valley Sewage, including an investigation into the trade wastes of the district, their probable volume and composition and the effect which they would likely have on composition of the sewage as discharged.

Q. Do I understand you had charge of that branch of investigation of the matter of trade wastes?

A. I did.

Q. You had assistants under you, did you not?

A. I did.

3582 Q. Have you familiarized yourself with the plans of the Passaic Valley Sewerage Commissioners with reference to the treatment of the Sewage of the district?

A. I have.

Q. How recently have you made investigation of that matter?

A. My last investigation was made February 10th, which was last Monday.

Q. I show you Complainants' Exhibit No. 135 in this case and ask you to look at it and see whether you have familiarized yourself with the contents of that exhibit—stipulation?

A. I have read this stipulation prior to this time and consider that I am familiar with it.

Q. Returning to the plans of the Passaic Valley Sewerage Commissioners with reference to this sewer, do you know what percentage of the trade wastes of the district are planned to be accom-odated by the sewer?

A. It is my understanding that when the full Passaic Valley

project shall have been completed the amount of trade wastes which the discharge from the sewer will then contain will be not more than ten per cent of the total volume so discharged.

Q. Have you made any investigations to di-cover data as to the trade wastes of the greater City of New York?

A. I attempted to gather data on this point but was unable to find any complete records of a study of the trade wastes of New York City. I have, however, compiled several tables from volume 9 of the 13th (1910) census of the United States which show the industry in New York City, and the different boroughs, having trade wastes. These are tabulated by first giving the character of the industry, the number of the establishments, total persons engaged, cost of the materials and the value of the material, added to by the manufacturer thereof. I have compiled similar data for the three largest contributors to the Passaic Valley Trunk Sewer, namely, Paterson, Passaic and Newark. It is possible from the data to gain some light on the relative amount of trade wastes discharged into New York waters from New York City, and to be anticipated in the discharge of the Passaic Valley Trunk Sewer.

Q. Do you know whether the trade wastes of New York City are discharged directly into the waters of New York Bay, into the Hudson River and the East River?

A. That is my understanding, yes, sir.

Q. Have you examined the reports of the Metropolitan Sewerage Commissioners in determining whether they have made any study of their own trade wastes?

A. I have for a number of years past read with interest the reports of the Metropolitan Sewerage Commission but I do not now recall that I have ever seen any precise reference to trade wastes in New York City giving details of importance; the matter is only referred to in a general way.

Q. Have you happened to observe whether they have given considerable attention to the trade wastes of the Passaic Valley district?

A. I think that they have yes, sir.

Q. Turning again to your tabulation, have you it in such form that you can separate it from other memoranda or so that I can offer it in evidence?

A. I think I have. I hand you six tables showing the data above referred to for New York City, Manhattan and the Bronx, Borough of Brooklyn and for the cities of Paterson, Passaic and Newark, all compiled from volume 9 of the 13th Census of the United States.

3584 Q. Compiled by whom?

A. Compiled by me.

Mr. Riker: I offer in evidence nine sheets embodying the matters that have been mentioned by the witness and ask that they be marked Defendants' exhibit No. 2 in this case.

By Dr. O'Sullivan:

Q. What was the source of knowledge you sought in making these tabulations or these tables?

A. Lacking information of a more definite and desirable character I attempted to show by comparison of the number of establishments, number of persons engaged in those establishments and the cost and value of material produced by those establishments, how the individual side of this problem in the Passaic Valley district compared with the industrial side of the sewage of New York City.

Q. I think you misunderstood my question, Mr. Johnson, I am asking for the source of the information which you have given here in tabulated form?

A. That is taken from the 13th Census of the United States.

Q. And from no other source?

A. No, sir.

Q. Does it represent any work done by you, other than the arrangement here?

A. No, sir.

Q. And the data comes from the Federal Census of 1910?

A. Precisely.

Dr. O'Sullivan: I object to this exhibit being received or marked in evidence on the ground that it represents no original work done by the witness.

3585 The Commissioner: Note the objection of counsel for the complainants.

(Marked Defendants' exhibit No. 2)

Further direct examination by Mr. Riker:

Q. Taking up defendants' exhibit No. 2 in this case, in a general way, does the character of the industrial establishment and the trade wastes to be expected from them in the greater city of New York differ materially from those of the Passaic Valley district?

A. In my opinion it does not.

Q. In your examination of the actual plans of the Commissioners for the construction of the Passaic Valley Sewerage Commissioners' Purification Plant do you or do you not find that those plans embody the devices and processes which are specified in the stipulation, complainants' exhibit No. 135?

A. From my examination of those plans, and especially on February 10, 1913, I am of the opinion that the plans do anticipate and comply with the terms of the stipulation referred to.

Q. In your opinion as an expert if the sewage of the Passaic Valley district as discharged into New York Bay shall have been so treated that there will be an absence in the New York Bay of visible suspended particles coming from the Passaic Valley sewage, that there will be absence of deposits objectionable to the Secretary of War of the United States in the New York Bay coming from Passaic Valley sewage, that there will be absence in the New York Bay and in its vicinity of odors due to the putrefaction of organic matters

contained in the Passaic Valley sewage thus discharged, that there will be a practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley
3586 sewage at the dispersion area or elsewhere, that there will be no injury to the public health which will be occasioned by the discharge from the said sewer into the bay of New York in the manner proposed and no public or private nuisance will be created thereby, and that there will be absence of injurious effects from said sewage discharged upon the property of the United States situated in the Harbor of New York and that there will be absence of reduction in the dissolved oxygen contents of the waters of New York Bay resulting from the discharge of Passaic Valley sewage to such an extent as to interfere with major fish life, there will be any nuisance created in New York Bay by such discharge?

A. In my opinion there will not.

Q. As a supplemental along those lines I would ask you if there is no public or private nuisance created by such discharge in your opinion can there be any such private or public nuisance created by it.

Dr. O'Sullivan: The question is objected to on the ground of ambiguity.

The Commissioner: Note the objection of counsel for complainants.

Mr. Riker: Counsel for the defendants says that it is his understanding that this suit is based upon a threatened nuisance to be created by this discharge and that this question is directed to the stipulation as providing expressly against any nuisance to be created.

(The question was then read by the stenographer.)

Dr. O'Sullivan: The question is again objected to on the ground that it is argumentative, and not fairly a question.

The Commissioner: Note the objection of counsel for the complainant.

3587 A. No.

Q. Mr. Johnson, in your opinion as an expert, if the sewage of the Passaic Valley district shall be treated in the manner described specifically in the stipulation, complainants' exhibit No. 135 in this case, will the result guaranteed and which I have read to you in my next to the last preceding question in your opinion be produced in the waters of New York Bay?

Dr. O'Sullivan: Objected to on the ground that there is no evidence in this case as to the sewage disposal method to be employed. Secondly, on the ground that this witness has disclosed no familiarity with or knowledge of the proposed system of sewage disposal.

The Commissioner: Note the objection of counsel for the complainants.

A. I believe that it will.

Q. Are you familiar with the present conditions of the Passaic River from the Great Falls at Paterson to the Newark Bay and of the Newark Bay to the Kill von Kull?

A. I am and have been for a number of years.

Q. Taking the Passaic River from its mouth at Newark Bay up to the upper boundary of the city of Newark, can you describe from a sanitary point of view the condition of the waters of the river at the present time?

A. During my quite frequent trips up the Passaic River during the past ten years I have had occasion both in summer and winter to observe the unsightly, unsanitary and offensive conditions of this stream. The facts are clear, that the stream is nothing more or less, nor has it been for years back, than an elongated septic tank. Matters discharged into this river from the various sources along its course, have resulted in the deposits of organic sewage matters which have been acted upon bacterially and being so acted upon putrefactive conditions have been set up and since these deposits are constantly being added to, such offensive putrefactive conditions have been constantly maintained. The river is black in appearance, foul-smelling and virtually devoid of oxygen, within the limit you have mentioned.

Q. What in your opinion has been the cause for the condition which you have described?

A. Nothing more or less than that the crude sewage matters entering the stream have overtaxed its sewage digesting powers and the velocity of the stream has not been sufficiently great to prevent the deposit of organic matters which, when undergoing bacterial decomposition and putrefaction, become blackened, give off foul odors and produce compounds which an active affinity for oxygen.

Q. Have you attempted in any way to determine the average length of time during which sewage matter discharge into the Passaic River remains in the river before it reaches Newark Bay?

A. I have not made such studies.

Q. Do you know whether they remain for a considerable time on the average?

A. Do you refer to sewage matters or—

Q. Yes?

A. There seems to be little doubt but that these sewage matters remain for the most part almost indefinitely.

Q. The waters of the river as discharged into Newark Bay, are they or are they not properly described as septic?

A. They certainly are properly described as septic—and then some.

3580 Q. What do you mean when you term the water septic, what is that condition, the septic condition that you refer to?

A. When the organic matters in the sewage are acted upon by bacterial life the first result is a reorganization of those compounds and until the oxygen in the sewage is practically used up, this is generally termed decomposition; after the oxygen has been used up it is generally termed putrefaction. Septic conditions therefore are those in which putrefactive agencies are present.

Q. As applied to sewage, do you make a distinction between fresh and stale?

A. Yes sir.

Q. At what point does fresh sewage become stale?

A. Practically at the point where the dissolved oxygen is all used up.

Q. Is that or is it not the point which the sewage begins to be septic?

A. It is generally so considered.

Q. Then generally speaking, is there any distinction between stale sewage and septic sewage?

A. Yes sir, there is.

Q. What is that distinction.

A. Stale sewage if it remained stale and did not enter the putrefactive stage, would probably never create serious offense, but as it enters the putrefactive stage compounds are formed which rapidly use up oxygen in the waters into which such septic sewage is discharged and furthermore offensive odors are given off, and other undesirable features accompany the state of putrefaction.

Q. Are there then degrees of septicization; in other words, you spoke of the waters of Newark Bay as being septic, and "then some." I suppose you meant by that, did you not, that there are degrees?

A. Yes sir, I did. Over-septicization is a thing particularly guarded against in the design and operation of sewage purification works. It should always be guarded against in propositions like this, where sewage is to be discharged into public waters and disposed of by dilution. Organic matters undergoing septicization after passing a certain point, produce large quantities of sulphur compounds and iron compounds in combination with sulphur, which rapidly deplete the body of water into which they are discharged, of the oxygen it may contain. Therefore the more septic, within certain limits, sewage may become the more difficult it is to properly dispose of it either by artificial methods of purification or by natural dilution and dispersion.

Q. Returning to the waters of the Passaic River, can you trace their progress from their entrance into Newark Bay—where do they go?

A. It is very clear to me from the data which have been compiled particularly by the Metropolitan Sewerage Commission, that the waters of the Passaic River, or a large part of them, pass out into New York Bay through the Kill von Kull.

Q. What effect on the waters of New York Bay does the discharge of waters from the Passaic River have, with reference to their purity?

A. In considering points along this line I made it a point to look up precise data recorded by the Metropolitan Sewerage Commission in its report of 1912. I there find that the average dissolved oxygen contents of the waters of Kill von Kull on the ebb and flood tide, was, in the year 1911, 74 and 76 per cent respectively. This indicates that the discharge of the Kill von Kull, polluted by the water of the Passaic River is in much better condition to be used as a digestive agent for sewage than the waters of the Hudson River or the East River at the Battery, where the dissolved oxygen contents of these rivers is much lower.

Q. What in your opinion, Mr. Johnson, will be the effect of the discharge of the sewage of the Passaic Valley district as proposed by the Passaic Valley Sewerage Commissioners upon the waters of Upper New York Bay as compared with the result of the present discharge of the Passaic River waters through Newark Bay and the Kill von Kull in to the same waters?

Dr. O'Sullivan: The question is objected to on the ground that there is no evidence of record which *which* disclose the fact whether or not this witness does or does not know what form the proposed discharge will be in as to its condition of purification or as to what method would be employed in the purification.

The Commissioner: Note the objection of counsel for the complainant.

A. I have made a study of the probable composition of the sewage of the Passaic Valley district and have ascertained the facts that the average velocity of flow of the sewage in the Trunk sewer will be approximately three feet per second. With these premises and with the further information I secured in 1907 on the composition of various sewers discharging at present into the Passaic River but which in the future will discharge into the Trunk Sewer, referring in this particular to the amounts of dissolved oxygen which these discharges contain, I am of the opinion that, as received at the treatment works in Newark, the sewage will normally not be septic, and at no time more than slightly so, if in fact at any time it is. The treatment giving the sewage at the proposed works near, Newark, will in my opinion be sufficient to remove objectionable suspended matters to such an extent that, as discharged at the 3592 dispersion area near Robbins Reef Light, the sewage of the

Completed Passaic Valley District project will not be so offensive or deleterious to the waters of Upper New York Bay as would be the case if these sewage matters were obliged to find their way into New York Bay by way of the Passaic River and Kill von Kull as is the case at present.

Q. Have you any knowledge of the method of discharge of sewage from the greater City of New York into the Hudson and East Rivers and Upper New York Bay?

A. I have, yes sir.

Q. How is that sewage discharged?

A. All of the sewage of New York City is discharged, through several hundred outlets at or near the bulkhead line. In some cases conditions about the shore have become so offensive that the sewers have been carried out to the pierhead line, and this is all. This condition not only holds true of New York City as referring to the Hudson River, New York Bay and East River, and its tributaries, but also as to Jamaica Bay where the sewage is all discharged at the shore line.

Q. For the greatest part is it or is it not untreated and crude?

A. It is practically all untreated and in its crude state.

Q. Mr. Johnson, from the point of view of your profession of sanitary engineer what feature of the discharge of the sewage of New

York as it is at present conducted seems to be the most objectionable?

A. Undoubtedly the most objectionable feature associated with the present method of discharge of the sewage of New York City is the fact that it is discharged in an untreated state, contains organic and mineral suspended matters, of which the former
3593 only are important so far as creating a nuisance, and because of the fact that this discharge takes place near the shore line where the opportunities for complete and satisfactory dispersion throughout the Waters of New York Bay are at a minimum and where the opportunities for heavy deposits of these suspended organic matters are at a maximum. This is true because of the fact that the swiftest currents are found in midstream or in line with the channel; around the shore lines these velocities are low and not sufficiently swift all of the time to keep the heavy suspended matters in suspension. These matters are more than usually large in size, or particles, for the reason that the sewers particularly of Manhattan because of the peculiar shape of the island, are short, the distance of travel of these matters from the point of initial contribution, is short, opportunities for these matters to be broken up in transit in the sewer are slight and therefore these matters come out into the waters of the Bay or the rivers in practically the same condition in which they were deposited, or very slightly broken up. This — not usually the case. In most sewers the solid matters have an opportunity to be broken up into small pieces which require less high velocities to keep them in suspension and prevent their deposit in the bodies of water into which they are discharged.

Q. What is the result of the deposit of this solid matter upon the floor of New York Bay or of any other body of water, from a sanitary point of view I speak now?

A. These matters of necessity, as now deposited by New York City, are for the most part *are* deposited near the shores but, also, over practically the entire harbor bottom. From a sanitary standpoint I can only consider the possible debilitating effect on the human organisms which might be created by such gases as
3594 are given off by the decomposition and putrefaction of these matters. So far as actually effecting the health of the community at the present time, I think that is insignificant so far as vitiating the air which the people of that community breathe.

Q. What then in your opinion is the effect of the deposit of this solid matter upon the floor of the harbor upon the digestive capacity of the waters of Upper New York Bay?

A. The putriferative agencies which are constantly present and active in these deposits on the harbor bottom set up and maintain an action which produces compounds and gases which are more destructive in the absorption of oxygen from water than would be many times the same volume of crude sewage which had not undergone septicization. The greatest effect of the waters in the harbor is this abnormal absorption of oxygen by these compounds which are constantly undergoing putrefaction on the bottom of the bay.

Q. Has your attention been directed to any determination of

oxygen contents of the waters of the Hudson River at its mouth and of the East River at its mouth?

A. Yes sir.

Q. What is the average as you have had your attention drawn to it, and from what sources is the average obtained?

A. I have personally studied the report of the Metropolitan Sewerage Commission for 1912 complainants' exhibit No. 157, and from the data given in that report have prepared a table which I hand you in which are summarized the data in the Metropolitan Sewerage Commission report above referred to bearing on the oxygen contents of New York's waters.

Q. Taking the map of the Hudson River and assuming that the the average oxygen contents is what has been determined in the report, what is that figure?

3595 A. At the mouth of the Hudson River the oxygen contents on both sides is 56 per cent saturation.

Q. And at the mouth of the East River?

A. That is 55 per cent.

Q. Do you or do you not find in those figures a confirmation of your statement as to the results of the deposit of sludge matters on the floor of the harbor from the sewage of New York City?

A. I do decidedly.

Q. You handed me a blue print containing a table and I understand that you prepared this from the Metropolitan Sewerage Commissioners' 1912 report complainants' exhibit No. 157?

A. Yes sir.

Q. Did you prepare that table yourself?

A. That table was prepared in my office under my direction and was personally checked over by me; I believe it to be a true transcript of the record.

Mr. Riker: I offer that in evidence and ask that it be marked defendants' exhibit No. 3.

By Dr. O'Sullivan:

Q. What does this blueprint that you have just handed to Mr. Riker and which has just been offered in evidence purport to be?

A. That is a table in which are brought together the data given in a report in the Metropolitan Sewage Commissioners for 1912, showing the results of the determinations made by that Commission of the amount of dissolved oxygen in the water of New York Harbor and at other points, throughout the year 1911.

Q. What part did you actually take in the preparation of this tabulation, you yourself personally?

A. Nothing in the tabulation, I checked the table as you
3596 see it from the records read from the Metropolitan report by another man.

Q. Who selected the figures that are the basis of the computation here?

A. I did.

Q. Did you make the computations themselves?

A. No sir.

Dr. O'Sullivan: I object to the marking or the admission in evidence of this document on the ground that it does not represent any work done by this witness.

The Commissioner: Note the objection of counsel for the complainant.

(Marked Defendants' Exhibit No. 3.)

Further direct examination by Mr. Riker:

Q. Did your conclusion as to the fact of a deposit in the form of sludge—you call it sludge don't you?

A. Yes sir.

Q. —on the floor of harbors supported by authority?

A. It is, yes sir.

Q. Will you refer to some authority on that subject?

A. Doctor Adeney.

Q. Who is he?

A. He is an eminent British Sanitarian.

Q. Yes.

A. Doctor Adeney in his report to the Metropolitan Sewerage Commission calls attention to this point—

Q. What report do you refer to?

A. 1912.

3597 Q. Complainants' exhibit No. 157?

A. Yes, sir.

Q. Proceed.

A. He says that the deficiency in dissolved oxygen from which as the Metropolitan Commission has shown the waters of harbor generally suffer at the present time, is chiefly, in the opinion of the writer to be ascribed to sewage solids which have been for some years past, and are, *accumulating* over the greater part of the harbor and are there forming foul deposits and permanent sources of injury to the waters flowing over them.

Again, on pages 117 and 118 of complainants exhibit No. 157 Doctor Adeney has this to say:—"The harbor waters are quite capable of satisfactorily disposing of the liquid sewage matters from the whole population of greater New York and they will be for many years to come provided that the solid matters in suspension in the sewage be first removed and that the discharge of the liquid matters be strictly limited and controlled so as not to over pollute any portion of the harbor waters."

Q. Mr. Johnson, have you made any study of the effects of the treatment as it is proposed to be administered to Passaic Valley sewage as defined in the stipulation which is complainants' exhibit No. 135, so far as relates to the question of the deposit of solid matters in Upper New York Bay?

A. Yes sir I have.

Q. What have you concluded from such studies as to the percentage of solids which will be removed by the treatment described by the stipulation in this case?

Dr. O'Sullivan: The question is objected to on the ground that there is no evidence in this case so far disclosing what the method of sewage treatment is proposed to be, nor is there any evidence so far from this witness that he is familiar with such processes as contemplated to be put in use by the Passaic Valley Sewerage Commissioners.

The Commissioner: Note the objection of counsel for the complainant.

Mr. Riker: Counsel for the defendants suggests that the question is directed to the treatment described in the stipulation.

A. From the results of my personal study of the efficiency of sewage purification devices similar to those called for in the stipulation I am of the opinion that the percentage removed of solid matters from the discharge of the Passaic Valley Trunk Sewer will be about 50 percent or more of the total suspended solids contained in the crude sewage as delivered at the treatment works near Newark.

Q. The percentage remaining in the sewage after treatment by the methods described in the stipulation will be of what character so far as specific gravity is concerned?

A. After passing through the various parts of the treatment works for sewage as discharged in my opinion will contain only such particles of suspended matter as would be in a very finely divided state of sub-division, and of a specific gravity sufficiently low to preclude their deposit to any material degree, if at all, on the bottom of New York Harbor, in view of the swiftly moving current therein.

Q. What would be the final disposition of the remaining solids in suspension so far as the waters of New York Bay are concerned?

A. I can conceive of a condition where these matters will remain in suspension for a practically indefinite period, being ultimately swept out beyond the Narrows and inoffensively and permanently dispersed in the sea.

Q. If the treatment which is described and prescribed in the stipulation which is complainants No. 135, should be applied to the sewage of the city of greater New York and that of the shores of the Bay which are within the limits of New Jersey have you attempted to make any determination of the probable capacity of the waters of New York Bay for sewage digestion with reference to the number of the inhabitants that will be served?

A. Yes sir.

Q. What result have you reached along those lines?

A. You are referring now to future possible conditions?

Q. Yes.

A. Studies of the possible capacity of water for digesting sewage have been going on for many years; some twenty-five years ago Mr. Rudolph Herring made such study and came to the conclusion that where the dilution of the sewage was less than one part of sewage to sixteen parts of water objectionable conditions were likely to arise; this is equivalent to two and a half cubic feet per second of water per 1000 people contributing the sewage. He furthermore

states that where this dilution is increased to one to forty-five possibility or probability of offensive conditions being set up are extremely slight. This refers to about seven cubic feet per second of diluting water per 100 population contributing. Mr. Goodnough, Chief Engineer of the State Board of Health of Massachusetts, has also given much attention to this point and sets the limit of dilution at one to twenty-three and one to thirty-six, the safe dilution being somewhere between the two. From such standards as these, which are now quite generally recognized as standards and from 3600 such observation along this line I have made personally I have been able to arrive at certain deductions from which I can answer your question.

I have assumed a flow of dilution water equivalent to five cubic feet per second per thousand population. This appears certainly to be on the safe side.

If the sewage is well mixed with the water adequate dilution in New York Harbor is afforded for the sewage of 18,000,500 people. Furthermore, with such treatment as will be given the Passaic Valley sewage given to the sewage of New York, I believe this population can be doubled, practically speaking, provided every available opportunity to make use of the diluting powers of the waters of the bay is grasped.

Q. Then under the conditions that you assume, that the opportunities are taken advantage of, of dilution, sewage treated in the way the stipulation provides for the Passaic Valley Sewage can be digested in your opinion for a population of from thirty-five to forty million inhabitants.

A. I believe that is generally true, and furthermore I believe it is wise to consider in this connection the absolute impossibility of Metropolitan New York ever reaching such a population.

Q. In taking advantage of the diluting power of New York Bay has the question of the depth of discharge of sewage any relation to that question?

A. It must of necessity have a great deal of significance particularly in this case, where the sewage is proposed to be discharged at a depth of not less than forty feet below the surface of the water. As discharged at that great depth, in the presence of constantly moving tides, tidal currents, the angle of approach to the 3601 surface will be materially flattened, and in this way better dispersion of sewage effected.

Q. Has the matter of plurality of discharge points any relation to the dispersion of the sewage?

A. That most assuredly will add to the efficiency of the proposed method of disposal. The discharge of this sewage through multiple outlets, in all there are some one hundred and fifty, spreading out over an area three and a half acres in extent, it is — my opinion bound to produce the desired result, namely, practically complete dispersion of liquid sewage throughout the entire body of moving water.

Q. In this aspect, how do the sewers of the city of New York

comply, as far as you have observed them with the requirements of deep discharge?

A. I have not studied all of the sewers of New York but such of those as I have studied, and I think it is generally true of all of them, discharge practically at the surface and at or near the shore line where opportunity for dispersion afforded in the case of the Passaic Valley project are not present. It is about the poorest method of sewage discharge that could be thought of.

Q. It is probably the least expensive, is it not?

A. Yes sir.

Q. Have you made any endeavor to determine the average age of the sewage of the Passaic Valley as it will be delivered at the disposal works, as proposed, on Newark meadows?

A. I have. It is rather difficult to get at this in *practice* terms but it appears clear that the sewage leaving Paterson will arrive at Newark some eight hours after its initial discharge at the upper source; all this time however it is flowing in a sewer only partly

3602 full the current being swift, namely, as before stated, about three feet per second, lineal velocity, and all along its course it will have the sewage discharged from various laterals, many of which will discharge sewage containing considerable quantities of dissolved oxygen, and considerable ground water which naturally contains dissolved oxygen will also find its way into the sewer. These conditions will not tend to encourage putrefactive conditions in the sewage. There are some trade wastes which discharge into the sewer materials which have a germicidal effect on bacterial life. From such studies as I have made of this phase of the problem, I am of the opinion that these wastes will not materially affect the bacterial contents of the sewage as a whole; But at the time of their discharge their effect may be felt and serve as another agency against the maintenance of putrefactive conditions.

Q. When you say eight hours from Paterson is that the extreme the maximum age, of sewage that is discharged?

A. No sir; it is retained for about one hour under conditions of maximum flow through the tunnel into New York Bay a distance of some five miles more; this would add to the age of the sewage perhaps three hours.

Q. What proportion of the total discharge at the treatment works would be represented by the sewage of Paterson, if you know?

A. From such observations as we made in 1907, I believe the sewage of Paterson represents some twenty per cent of the total flow of the sewer under maximum conditions of discharge.

Q. Where is the origin of the largest part of the sewage that will be discharged at the treatment works?

A. At Newark.

Q. When you mentioned the eight hours was that the average for the whole district, or was that the age of the sewage coming from Paterson?

3603 A. That was the age of the sewage from Paterson, the maximum age. The Sewage from Newark would be less than four hours old at the time of its discharge.

Q. Does the sewage in motion at the rate of three feet per second, lineal velocity, become as readily aseptised as sewage at rest?

A. No sir, it does not for the reason that the best way to encourage a septic condition of sewage is to allow it to flow at a velocity sufficiently slow to permit the suspended solids which it contains to deposit; it is in these deposits that most active bacterial actions are maintained. It would be difficult for anything like intense bacterial action to take place in a flowing stream of sewage, especially a stream flowing at this relatively high velocity where the particles of suspended matter are kept in suspension or kept moving. The opportunity for bacterial mass action is slight.

Q. Have you made any observations or studies upon the effect of sewage pollution on fish life?

A. Yes sir.

Q. What has been those observations?

A. I have been more or less interested in the affect on fish of sewage matters for a dozen years. My first study of this question was in St. Louis in connection with the Chicago Drainage Canal Investigation, and more recently within the past year in connection with an investigation conducted by me for the New York State Conservation Commission into the question of shell fish pollution in Jamaica Bay.

Q. At St. Louis were your studies directed to shell fish or to major fish life?

A. They were directed to major fish life.

Q. In that investigation did you attempt to determine whether the meat of the fish was affected by sewage pollution?

3604 A. We were more particularly interested to determine whether these fish would take up pathogenic germs, and if these germs would be propagated, or if they would multiply, within the fish, and that that fish perhaps, migrating to a water of purer quality, might discharge these pathogenic germs and thereby render it dangerous for consumption.

Q. What did you determine in this investigation?

A. We determined that practically all of the fish to be caught in the Mississippi River, near the mouth of the Illinois River, which receives the discharge of the Chicago drainage canal, did contain at one time or another intestinal bacteria which had come from sources in the sewage of the sanitary district of Chicago, or at least so we were led to believe. The bacteria so gathered in by the fish did not multiply within the fish and could not be found within the meat of the fish but only in the intestinal contents thereof.

Q. Have you ever attempted to determine what percent of dissolved oxygen in the water enables fish to live?

A. No sir; I have not; I know that such observations have been made and I know in a general way what the results have been. Conversation with American and British sanitarians which have carried on such investigations, has led me to the conclusion that major fish life, with a few exceptions, can exist in waters in which

the dissolved oxygen contents is reduced to about thirty percent saturation, and in some cases even less than that.

Q. Have you from your own personal observations reached any conclusions as to what was the trouble with the shad, for instance, caught in New York Bay and Hudson River?

A. I have, yes sir.

Q. What is your opinion in reference to that?

A. For many years the Hudson River shad has been a
3605 back number and has passed out of use at least, because of the fact that the meat of these fish when caught is so permeated with the tastes of oil as to be highly unpalatable.

Q. What kind of oil?

A. It has always the taste of kerosene, petroleum.

Q. I think you said you made a recent study of some parts of New York harbor or Bay with reference to shell fish?

A. I did, yes sir.

Q. Where was that?

A. That was in the waters of Jamaica Bay.

Q. Did you find those waters particularly adapted under normal conditions to the propagation of oysters?

A. Under normal conditions I consider the waters of Jamaica Bay about the best that can be conceived of for shell fish cultivation.

Q. Is or is not — the home of the famous Rockaway oyster?

A. It is, yes sir.

Q. And Jamaica Bay is, I think, entirely within the State of New York is it not?

A. It is, yes sir.

Q. What results did you reach in your examination of the shell fish or oyster industry in Jamaica Bay in your recent investigation?

A. The waters of Jamaica Bay are very shallow and teem with microscopic life upon which shell fish feed; the water is about the desired degree of salinity for the favorable cultivation of shell fish; the bay has but one inlet, which also serves as an outlet to and from the sea, and breathes twice a day with the tide. The conditions as I have said, for shell fish cultivation are naturally ideal, but unfortunately the city of New York discharges huge volumes of sewage into this bay, the daily amount averaging between twenty and forty million gallons, daily. This sewage is passed
3606 through sewage disposal works before being discharged into the bay, but all of these works are inadequate in design and insufficient, and do little beyond removing a small amount of the suspended matters originally contained in the sewage. It so happens that this sewage from these various outlets on the north, east, west and south shores of the bay is diffused throughout practically the entire bay. It is a further fact that there are only small isolated areas into which the sewage does not penetrate apparently. The surprising fact developed in this investigation was the fact that whenever the sewage was carried by the currents—wait a moment, thought. This report has not been published and I may be jumped

on by the Conversation Commission of New York for giving it out.

Q. So far as you know are there any processes applied to the sewage discharging into Jamaica Bay which would serve as germicides for the pathogenic germs in the sewage?

A. Chlorine gas is said to be used at some of these works and during my investigations of the twenty sixth ward's plant in 1906, was being used, but with poor effect so far as its germicidal properties were concerned. Therefore it may be said that the attempt to destroy pathogenic germs in the sewage treated at these various plants around Jamaica Bay has been futile.

Q. In your opinion what result has already been reached, so far as the shell fish industry in New York Bay is concerned by the discharge of sewage from the greater city of New York?

A. The shell fish industry has been driven out of New York harbor by the successively greater pollution contributed to it in years past. There are a few isolated shell fish grounds in New York harbor from which shell fish still continue to be dredged but not with the authority of the City or the state, and *whatever* detected, it is my understanding that such oysters have been confiscated.

3607 Q. Assuming that germicidal application shall be made to the sewage now emptied into the waters of New York Bay, for the destruction of pathogenic germs, in your opinion can such process be applied to the sewage of the Passaic Valley district at the treatment works?

A. It can, and effectively, if occasion arises in the future to make necessary such treatment.

Q. If New York takes the precaution to preserve its shell fish industry by treating its sewage with germicides for the destruction of pathogenic germs, the sewage of this district will be susceptible to like treatment?

A. It will.

Cross-examination by Dr. O'Sullivan:

Q. Do you hold yourself out as a sewage expert, Mr. Johnson?

A. I do, yes sir.

Q. Did you ever study at any of our institution- for the education of a civil engineer?

A. I have attended lectures and am an associate member of the American Society of Civil Engineers.

Q. Is that a teaching institution?

A. It is.

Q. Have you ever taken any degree in civil engineering?

A. No sir.

Q. Have you ever taken any degree in bacteriology or biology?

A. No sir.

Q. Have you ever taken any degree in chemistry?

A. No sir.

3608 Q. Have you ever taken any educational degree at any of our teaching institutions?

A. No sir.

Q. You stated that among your experiences that you began as an inspector at Louisville, Kentucky, in 1895, is that right?

A. Yes sir.

Q. Later on you were assistant to Mr. George W. Fuller in his work there on water purification?

A. Yes sir.

Q. In 1899 you were an assistant under Mr. Miller and Mr. Robert S. Westson, were you not, in Washington?

A. I think that is the winter of 1898-9 that I was in Washington in direct charge under Colonel Miller and Mr. Westson of the experiments being carried on there into the purification of the Potomac River water.

Q. Did Mr. Westson direct the work there?

A. He was located in Boston and I reported to him each month.

Q. Who is Mr. Westson?

A. He is a sanitary expert, with offices at 14 Beacon Street, Boston.

Q. And is re-gnized as an authority on biological chemistry, is he not?

A. Yes sir; he has been associated with me on numerous occasions.

Q. On this occasion you worked under his direction, did you not?

A. Yes sir.

Q. Did you read his testimony as given in this case?

A. I have read much of it, yes sir.

Q. In the Chicago Drainage Canal investigations under whose charge was your work, and under whose direction?

A. My work was under the charge of the Water Department, originally, later being shifted to the Health Department.

3609 Q. Did you work under the direction of Dr. Ravold?

A. No sir.

Q. Was he not in charge of those investigations?

A. He was my associate; he was nominally in charge in his position as head bacteriologist of the city.

Q. Did you do any bacterial work there?

A. Yes sir.

Q. Was he your superior in that work or were you his superior?

A. He was my superior.

Q. The work that you described in 1901 was done directly under the supervision of both Messrs. Herring and Fuller, was it not in Philadelphia?

A. Mr. Herring was engaged for that work and placed me in direct charge of it he directing it from New York.

Q. And that related to water filtration?

A. Yes sir.

Q. The various matters that we have just now dealt with were all water purification schemes, were they not?

A. Up to this time, with the exception of the Chicago drainage canal,

Q. Was not the investigation in that case directed to the influence of the drainage canal on the water supply of St. Louis?

A. Yes sir, the effect of the sewage of the Chicago drainage canal on the water supply of St. Louis.

Q. And you were investigating the condition of the water supply of St. Louis?

A. I was investigating the effect of the sewage of the drainage canal of the water supply, tracing it back to its original source.

Q. But your examinations dealing with water or sewage in that particular connection?

A. Both.

3610 Q. Did you examine the water to find sewage, or the sewage primarily to discover how much it might possibly affect the water?

A. I took both things into consideration, examining bacteriologically and chemically the sewage as discharged at the Bear Trap Dam, and tracing it from that point through its four hundred miles of travel to the intake of the St. Louis water works.

Q. And did such work as you were doing contemplate a report as to whether or not the sewage rendered the water unfit for potable purposes?

A. More particularly was the investigation aimed at the determined whether pathogenic or diseases producing germs were carried from Chicago to the water supply of St. Louis; in that respect yes.

Q. And you found -- were carried to it, did you not?

A. I did not.

Q. Did you consult the work done by Dr. Ravold previously on this very same subject?

A. The work that Dr. Ravold had done previous to this investigation, as taken up by me, had been done in fragments and the investigation was not continuous and therefore the results attained up to the time I took charge of it were considered to be of little value.

Q. Did you read Dr. Ravold's experimental work with the bacillus prodigiosus?

A. Yes sir.

Q. And that he proved that that traveled from the Chicago drainage canal outfall to the intake of the St. Louis water supply?

Mr. Riker: The question is objected to on the ground that it is immaterial and irrelevant and not cross examination.

3611 The Commissioner. Note the objection of counsel for the defendants.

A. As a matter of fact the test for the bacillus prodigiosus was my idea; I made the test primarily and as you have already intimated did find the same organism in the tap water of St. Louis, and considered this to be fairly good evidence, but in view of the fact that I have also personally isolated this germ from the Ohio River water I did not consider that it might not be a natural inhabitant of the waters of the Mississippi River. The tests made later by Dr. Ravold also disclosed that fact that this germ was at times pre-

ent in the tap water in St. Louis, and it was not inconceivable to me on that account that these germs that he found at a date subsequent to the time when I found them, might have come from the bacteria which I had personally added to the Illinois River months before.

Q. Is it not a fact that the *bacillus prodigiosus* experimented with by Dr. Ravold were brought from Europe, the cultures which he afterwards developed and which — afterwards experimented with?

Mr. Riker: The question is objected to on the grounds as last stated, and also as leading the record up with immaterial matter.

The Commissioner: Note the objection of counsel for the defendants.

A. So I understand.

Q. Did you read Dr. Ravold's testimony, in its digested form or otherwise, given in the Chicago drainage canal case?

Mr. Riker: The question is objected to on the same grounds as last stated.

The Commissioner: Note the objection of counsel for the defendants.

A. I did, yes sir.

3612 Q. Does he in any way connect you with the experimental work with the *bacillus prodigiosus*?

Mr. Riker: The question is objected to on the same grounds as last stated, also on the further — that it is irrelevant as possibly showing the opinion of this gentleman of himself, but not of others, and that is not an issue in this case.

The Commissioner: Note the objection of counsel for the defendants.

A. I do not recall that he did.

A recess was then taken.

Q. Mr. Johnson, what was the object of Dr. Ravold's experiment and the experimental work that you did with the *bacillus prodigiosus*?

Mr. Riker: The question is objected to on the same grounds as last stated, as immaterial, irrelevant and incompetent.

The Commissioner: Note the objection of counsel for the defendants.

A. We selected the *bacillus prodigiosus* for this test for the reason that it closely resembles in its actions and its resistance to unfavorable conditions of environments the typhoid bacillus; we wanted to ascertain whether the typhoid bacillus, if present in the sewage discharge of the sanitary district of Chicago would travel some three hundred and sixty miles between Chicago and St. Louis and enter the water supply of the latter City. We took the bacillus *prodigiosus* for the reason that it is easily identified on culture medium.

Q. Did Dr. Ravold later testify that he found and discovered the bacillus prodigiosus at the intake of the St. Louis water supply?

Mr. Riker: The question is objected to on the same grounds as last stated.

The Commissioner: Note the objection of counsel for the defendants.

A. I believe that he did.

Q. You testified that you worked with the Maigen filter device at Philadelphia. Under whose direction did you do your work there in 1901?

A. My most active adviser in that work was Mr. Fuller, the partner at that time of Mr. Rudolph Eerring, under whose charge these investigations were being carried on and directed from New York.

Q. The work that you did at Little Falls on the filtration plant there, under whose direction did you do that work, Mr. Johnson?

A. Under the direction of the chief engineer and superintendent of the Water Company, Mr. J. Waldo Smith, and the consulting engineer, Mr. G. W. Fuller.

Q. You testified that you did some work of a chemical and biological nature in regard to the additional water supply for New York City. Under whose direction did you do that work?

A. That was in the department of chemistry and biology, at the head of which was George T. Whipple who had the title of department engineer; my title was field director and principal assistant engineer.

Q. In the Waterloo Iowa works under whose direction did you do that in 1903?

A. I am consulting engineer to the Waterloo Water Company. The work was carried on under my full direction.

Q. What part did George W. Fuller play in the direction of that work?

A. None.

Q. He had no connection with it?

A. No sir.

Q. In what capacity did you do the work for the Columbus, Ohio, plant?

A. As engineer in charge of the testing station, the work being nominally under the charge of Julian Griggs, chief engineer for the Board of Public Service, also being supervised by the consulting engineers Herring and Fuller.

Q. Who was the chief engineer in charge of the work at that time?

A. Julian Griggs.

Q. Who was the chief chemist in charge of the work?

A. I know of nobody by that title.

Q. What title did Mr. A. Elliott Kimberly bear?

A. He was my principal assistant chemist.

Q. Were you chemist in charge?

A. I was the engineer in charge.

Q. Who was chief of the chemical staff?

A. I was.

Q. Who was chief of the bacteriological staff?

A. I was.

Q. What position did Mr. Clarence C. Hoover occupy?

A. First assistant bacteriologist, after the resignation of Mr. William R. Copeland, who was first assistant bacteriologist until May 1905.

Q. Did not Mr. George E. Wilcomb take the position occupied by Mr. Copeland?

A. For a short time, about six weeks.

Q. Who did the actual bacteriological work?

A. The second assistant did the routine work, Mr. Copeland special work.

Q. Under Mr. Copeland's direction?

A. Under my direction.

Q. Mr. Copeland, you say, was an assistant?

A. Yes sir.

Q. So that you were chief chemist and chief bacteriologist directing the work of both departments in the Columbus, Ohio, plant, during 1905 and until 1906?

A. My title during the work of 1904-5 was engineer in charge and as such I directed the work of three departments, engineering, chemical and bacteriological.

Q. Did you collect any of the samples that were subjected to chemical analyses?

A. I did.

Q. Did you conduct any of the chemical analyses?

A. I did.

Q. How many assistants were there altogether in the chemical department?

A. Altogether there were three assistant chemists, Mr. Wilcomb the third man, and—that is all, there were three altogether in the chemical department.

Q. How many bacteriologists were there during the bacteriological work?

A. There were four, Mr. Wilcomb being one, and he, as before stated, served for six weeks.

Q. Was there not a fifth, a Mr. Jennings?

A. In the first part of the work Mr. Jennings served for a few weeks.

Q. Did any of the chemists collect any of the samples subjected to chemical analyses?

A. Almost without exception, all these assistants mentioned, on pages 9 and 10 of the Columbus report on sewage purification, written by me, took samples at one time or another for analyses; the routine duty of sample collection was in the hands of the inspectors, of whom there were five in all.

Q. So that you did the duty of inspector of chemist and of bacteriologist on this work; is that right, Mr. Johnson?

A. Well, at one time or another, yes; but it was my duty to direct the work of each department from the office, as is done in all such work as this, and in all lines of mercantile work.

Q. What engineering work did you do in connection with that plant?

A. The engineering work referred particularly to the operation of these various forty four devices which were under test and that referred to gauging the rates of filtration and such other things as would naturally come up under the general head and operation of sewage purification.

Q. Was the plant constructed and in operation before you were installed?

A. No sir.

Q. Did you have anything to do with the construction of the plant?

A. I was there during the latter part of its construction.

Q. Did you have anything to do with the construction work directly?

A. No sir, that was under the charge of Mr. Kimmler, an assistant engineer from the city engineer's office.

Q. Altogether what did the entire staff number both in the chemical and bacteriological work who did this chemical and bacteriological work?

A. They averaged about nine men.

Q. Look at page nine of that report and see if you did not state positively that they averaged fourteen men.

A. You asked me how many were engaged on chemical and bacterial work; fourteen includes the inspectors.

3617 Q. Were they not engaged in securing the samples?

A. Yes sir. They did not do analytical work.

Q. Did they not collect most of the samples that were worked upon later by both the chemists and bacteriologists?

A. They did, that was their duty.

Q. Did not you have two assistant engineers on that staff, too?

A. Yes sir.

Q. And all those men reported to you and you fashioned their reports into a report for your superiors in that Columbus plant?

A. The head of each department reported to me every morning for instruction, which he followed during that day's work. At the close of the week they each presented a report setting forth the results which they had obtained during that week's time, and the result of all those reports I prepared of each month, setting forth the progress of the work and after its completion I prepared the final report which was published by the city in 1905.

Q. And all that work of the staff which you have just been describing and your own work was under the supervision of Mr. George W. Fuller?

A. He was an advisor.

Q. Who supervised the work?

A. Hering and Fuller consulting engineers, and Julian Griggs chief engineer.

Q. In 1906 you described a tour in which you made investigations of sewage disposal systems; was that confined to sewage disposal plants in those locations?

A. No sir.

Q. Did you travel in the interests of any particular device for water purification?

A. I traveled as the expert of the Jewell Export Filter Company.

3618 Q. Is that a patented device?

A. What, the filter company?

Q. The Jewell Export Company?

A. They have patents, yes.

Q. And these were calculated to improve the water supply wherever they were put in use, is that so?

A. They are, yes sir.

Q. In 1907, on your return from this tour, in the interest of the Jewell Export Filter Company, did you enter the service of Hering and Fuller?

A. Yes sir.

Q. As an assistant?

A. As an assistant engineer, yes sir.

Q. Were you at any time connected with the Jersey City Water Supply Company?

A. Yes sir.

Q. What year was that, Mr. Johnson?

A. 1908 and 1909.

Q. Did you make any investigation of the water supply?

A. Yes sir.

Q. Did you later testify in a suit in which the purity of that water was at issue?

A. I did, yes sir.

Q. And you testified in favor of the Water Company and against Jersey City.

A. That is true, yes sir.

Q. Did you change your attitude at any time later with regard to the potable water that was in issue at that time between the Jersey City Water Supply — and Jersey City?

A. I did, yes sir.

Q. When did you make that report to Jersey City?

3619 A. December 7, 1912.

Q. Did the testimony which you gave in 1910, in favor of the Jersey City Water Supply Company conflict with the report given to Jersey City on the same topic and which was given in 1912, in December?

A. No sir, in no particular.

Q. When you were a witness for the Jersey City Water Supply Company did you not testify that it was not necessary to purify the sewage before discharging it into the water supply?

A. No sir, I think not.

Q. Are you positive, Mr. Johnson.

A. You have the record you can read it to me, and I can tell you whether I said so or not. There are a number of assumptions that have a good deal to do with the answers we give to certain hypo-

thetical questions, which a number of people seem to have misinterpreted.

Q. As you recall your testimony didn't you positively state in this case under oath that it was not necessary to purify the sewage before discharging it into the water supply?

Mr. Riker: The question is objected to on the ground that the witness has already answered it.

The Commissioner: Note the objection of counsel for the defendants.

A. I should much prefer to see the testimony if you have it; I think it would be better to read it.

Q. Is that your best answer?

A. Most assuredly.

Q. Didn't your report in December, 1912, to Jersey City urge the necessity for the purification of the sewage before it was discharged into the water supply?

A. It did, for the very good and sufficient reason that the condition on that water shed have changed materially since the testimony I gave in the New Jersey suit.

3620 Q. What changes had taken place in those two years?

A. The degree of pollution of the feeders of the Boonton reservoir.

Q. Had the volume of sewage increased?

A. It is difficult to state in precise figures, but I should judge that it had.

Q. Had the character of that sewage been in any way altered?

A. Judging from analyses as have been made since the time I gave my testimony and such analyses as were made before I gave my testimony, the fact is plain that the water has been gradually growing worse and worse each successive year, indicating clearly that the amount of pollution contributed to the Boonton reservoir has been increasing year by year?

Q. Quantity?

A. As to quality.

Q. Now as to the character, or equality of the polluting media, how about that?

A. I should say the same thing in regard to the quality, because the bacterial analyses show a steady increase up to the present time.

Q. Have they added any new plants in those two years, that have contributed extra amounts of sewage or sewage of more polluting character?

A. I could not testify as to that, the evidence at the other end is good enough for me although I have been over the watershed and personally viewed its unsanitary condition. In 1908 the quality of the water was such that in the opinion of all who were connected with the case, and of myself in particular, the water was not so polluted but that it could be effectively made safe for human consumption by the addition of a sterilizing agent at the dam. This sterilizing method had only then come into vogue, as a matter of fact I put it into use for the first time in this country in connection with

the purification of the water supply of Bubbling Creek in the
3621 Union Stock Yards at Chicago, in September, 1908.

Q. What was that agent?

A. Hypochloride of lime.

Q. When did you first advocate the use of hypochloride of lime
as a sterilizing agent?

Mr. Riker: The question is objected to as being entirely without
the issue, immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defend-
ants.

A. May 11, 1908.

Q. Had it not been described long before that by Professor Earl B.
Phelps?

A. In connection with the treatment of the sewage I think it had
but not with the purification of water in this country.

Q. Are you quite sure of that?

A. If it had been described it had never been used.

Q. Had it not been used at the Lawrence experimental station in
sewage?

A. I am speaking of water.

Q. And had it not been used on water?

A. I think not, in fact I am positive it had not.

Q. Your testimony in 1910 opposed the use of this sterilizing
medium, didn't it?

A. No sir.

Q. Did you advocate it?

A. I recommended it.

Q. For sterilizing the waters?

A. Yes sir.

Q. And that obviated the necessity of in anyway purifying the
sewage?

A. At that time, yes sir.

3622 Q. And later on, two years later, you advocated the purifi-
cation of the sewage in addition to the sterilization of the
water did you not?

A. I did, and for this reason:—In 1908 when this process was
recommended for adoption by the Jersey City Water Supply Com-
pany, for use at Boonton, we had in this country very little ex-
perience in the line of what hypochloride would do in that respect
we were on insecure and indefinite grounds as to the limitation of
the process; we knew that under the conditions to be met in the
treatment of the Boonton supply this process was safe and effective
we assumed that the amount of pollution on the water shed would
not grow materially less in years to come. But since that time we
have learned the limitations of the process and we know that you
cannot go on indefinitely, adding indefinite amounts of hypo-
chloride of lime to a water without imparting to that water un-
desirable and inadmissible tastes and odors of the chemical itself.
As the organic matter on the water shed, washed into the river, in-
creases the organic matter in the reservoir itself necessarily must in-

crease, and because of this increase in the polluting matter it becomes necessary to use greater quantities of the germicidal agent than were required when we first started the process. The limit is rapidly approaching. We know positively that when we add to the Boonton water a quantity of the germicidal agent three times in excess of that which we started with, the water is given an objectionable taste. We have already doubled the original dose to meet the requirements of the increased pollution.

Q. When you said you doubled the original dose do you mean the dose that you advocated in 1910?

A. Yes sir.

Q. Did Jersey City lose or win that suit?

A. They lost it.

Q. In all of the matters that we have now been asking and 3623 answering questions on, did they all relate to fresh water conditions?

A. Yes sir.

Q. Did you ever design and construct and put in operation a sewage disposal plant?

A. So far as any consulting engineer ever does design, construct and put in operation a sewage or any plant, I have.

Q. Where?

A. Take the case of Reading, Pennsylvania, where I was associated with Hering and Fuller. The plans for this work were prepared in the office at 170 Broadway, and there, and at Reading, in the office of the resident engineer, I advised as to features of design throughout the preparation thereof. During the construction of these works I advised the resident engineer as to various features of the construction work, and at times actually took his place. As far as the operation of the work is concerned I was the active representative of the firm Hering and Fuller throughout the entire work.

Q. And under the direction of both Mr. Hering and Mr. Fuller of the work done?

A. That is not so because that was a piece of the work which was given over to me and I advised with them as to its prosecution.

Q. Before adopting any plans in the furtherance of the work itself?

A. I cannot say that because there were many steps taken in the construction of the plant in its operation that I personally directed without advice from anybody.

Q. Are you now in the employ of the New York City in any particular capacity?

A. No sir, but I am subject to call as I have been for many years.

3624 Q. What Department of New York City have you served?

A. The Department of water supply, gas and electricity.

Q. In what capacity?

A. As consulting engineer.

Q. Are you now an employee of the City of New York or any of its departments?

A. No sir.

Q. When did you sever your connection with the New York State Conservation Commission?

A. June 11, 1912.

Q. You testified to some work done during your connection with the New York State Conservation Commission; I ask you who did the bacteriological work with reference to these shell fish?

A. There was none done.

Q. Who did the chemical work relative to the condition of the water flowing over these oyster beds?

A. There was no chemical work done in this investigation.

Q. Who did the microscopical work relative to the deposits, or the water that covered or surrounded these oysters in Jamaica Bay that you mentioned?

A. We relied for such information as your questions speak of upon published reports of such work done by the members of the Water Department, the Sewer Department, and the Metropolitan Sewerage Commission.

Q. All employees of New York State and New York City?

A. Yes sir.

Q. Did you depend to any extent upon the bacteriological or other work done by Dr. Stiles of the Federal Government?

A. Very little, his bulletin was not published at the time my report was made.

Q. Were you familiar with any of the facts which later appeared in that bulletin?

3625 A. Yes sir.

Q. And prior to its appearance in published form?

A. Yes sir.

Q. The matter which you have testified to relating to the New York State Conservation Commission, has that been published yet?

A. It, I understand, is in the hands of the printer.

Q. But has it been actually published?

A. Not to my knowledge.

Q. The matters which you have testified to you have gathered during your connection with the New York State Conservation Commission?

Mr. Riker: The question is objected to because it is assumed that he has testified to no matters gathered in that way, the fact being that he declined to testify as to the contents of that report.

The Commissioner: Note the objection of counsel for the defendants.

A. With regard to Jamaica Bay, if that is what your question relates to, I would state that such statements as I have made are not entirely based upon this report but upon personal observations made years ago with respect to the amount of sewage entering the harbor, its direction and flow.

Q. How many years ago?

A. Six.

Q. What work did you do in Jamaica Bay six years ago?

A. I made an investigation of the sewage works about Jamaica

Bay under Mr. Hering, for the Department of Sewers in New York in the winter of 1906 and '7.

Q. Who was in charge of that bureau in Brooklyn at that time?

A. I could not tell you. Furthermore I must amend that statement by saying that this investigation was made for chief
3626 engineer Lewis of the Board of Estimates and Appointments and not for the Bureau of Sewers.

Q. Do you know who was in charge of the Brooklyn sewers at that time?

A. I was trying to think, but I cannot recall now. The present chief engineer is E. J. Fort.

Q. Was he in charge at that time?

A. I think not.

Q. What investigations did you conduct at that time that had any relation to the oysters or oyster beds?

A. I made an investigation of each of the sewage works with the view of ascertaining whether they were doing the work required of them and whether the effluent as discharged in Jamaica Bay was of the character which was required.

Q. Did you examine any samples of the oysters?

A. No sir.

Q. Did you examine the oyster beds themselves?

A. I did not. You refer I suppose in that question to 1906?

Q. You said about six years ago.

A. That is right.

Q. I am speaking of that time.

A. I so understand.

Q. When did you actually make any personal observation either in relation to the oysters or the oyster beds?

A. In the early part of 1912.

Q. You were then employed by the New York State Conservation Commission?

A. Yes sir.

Q. And in your position and your relation towards them you made investigations?

3627 A. Yes sir.

Q. Did you make any report on it?

A. I did.

Q. And the report has not been published up to date?

A. To my knowledge it has not.

Q. What you have testified to relating to oysters and oyster beds is entirely predicated on the observations you made at that time?

A. No sir.

Q. What other observations did you make beside those you made for the New York State Conversation Commission in relation to oysters or oyster beds?

Mr. Riker: The witness has been asked the question and answered that he made observation in 1906, in regard to Jamaica Bay in connection with the sewers, and I object to the question.

The Commissioner: Note the objection of counsel for the defendants.

A. The whole question of oyster pollution or shell fish pollution has been one in which I have been interested for a great many years, but so far as making personal observation is concerned, bacteriologically, I have made none. My information has been gathered from visits to various places where the shell fish industry was involved and by close attention to the literature on the subject which has appeared from time to time.

Q. Have you ever at any time conducted bacteriological examinations of either oyster liquor or oysters?

A. I have for my personal satisfaction, the work being done at Cincinnati in 1908.

Q. Is that work printed or published in any form?

A. It is not.

3628 Q. What is greening in oysters due to?

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendants.

A. That is a technical term; I presume the answer you require is that greening is due to the algae which are taken in by the oysters as food, although a typical greening of oysters is brought about in some waters of Europe, particularly on the coast of France, by the presence in those waters of copper compounds.

Q. Have you ever found greening in any of the oysters taken from any of the waters of New York Harbor?

A. I testified I made no examination of oysters in Jamaica Bay. It was not necessary.

Q. When were you connected as one of the commission-s of New York City in the department of water supply on the Jerome Park Filter Plant?

A. June, 1912.

Q. When did you sever your connection.

A. June, 1912. I did not sever it, it was severed.

Q. When were you first connected with the Passaic Valley Trunk Sewer project?

A. It may have been the very last part of 1906 but it is my impression that I began work on it in the early part of 1907.

Q. What work did you do then?

A. When this work was taken up by my office, at the office of my firm—

Q. What firm was that?

A. Hering and Fuller—in the office, I was the assistant engineer; the department given me to work up was the disposal of the sewage, which related to study as to its composition and the trade waste problem.

3629 Q. Did you make a study at that time of the trade wastes of the Passaic Valley that were discharged into the Passaic River?

A. I did, yes sir.

Q. Occupying how long a time during 1907?

A. The investigation extended over some six or seven months

I should say, consecutive months, all the time of which was not devoted to this work, and furthermore there were days spent on it even after that. The bulk of the work was done within six months' time.

Q. And was chiefly what so far as you were concerned, what was the character of the work?

A. Laying out instructions for the field force to follow, examining their reports, recording the results and making personal trips to check up the results recorded by them.

Q. What did the field force consist of, chemists, bacteriologists, engineers or what?

A. The field force was in charge of Mr. Samuel A. Greeley, but the names of the members I cannot recall; there was one whose name was Charles E. Weltner.

Q. In connection with the trade wastes and the sewage being discharged in 1907 and for the six months that you were occupied in investigation it, did you do any bacterial work in regard to that sewage or trade wastes?

A. No sir.

Q. Did you do any chemical work?

A. Sometimes chemical work was done, yes sir.

Q. What did that consist of?

A. That refers to trade wastes, does it?

Q. Either sewage or trade wastes.

A. It referred to the determination, in the case of trade waste only of dissolved oxygen.

3630 Q. Relative to sewage, what did it consist of?

A. That is what I referred to, not in connection with the trade wastes.

Q. How did you find the oxygen contents of such part of the Passaic River as you examined at that time?

A. We selected thirteen sewer outlets as follows:

No. 1. In the Passaic sewer, opposite Dock St. Sewer 4' 10½" x 3' 6". This sewer drains storm water from 650 acres and house sewage from 30 acres.

No. 2. Lafayette St. sewer, 20" diam. drains house sewage from about 620 acres, storm water from about 30 acres.

No. 3. Lodi St. sewer, 20" diam. Drains area of 100 acres largely built up with factories.

Rutherford.

No. 4. Pierpont Ave., sewer 24" diam. House drainage from 138 acres.

Second river.

No. 5. Orange, Bloomfield, Glen Ridge and Montclair Joint Sewer. Diam. 45". Drains 9,358 acres.

Mr. Riker: I ask to have that joint sewer at Second River excluded on the ground that the municipalities just mentioned are not within the territory to be drained by the Joint Sewer.

The Commissioner: Note the request of counsel for defendants.

Witness (continuing): Newark.

No. 6. Carlisle Place Sewer 6' 9" x 9' 3". Drains an area in Newark of 1,750 acres and in East Newark of 2,427 acres.

No. 7. Vernon Ave. sewer, 5' 3" x 6'. Drains an area of 1,206 acres.

No. 8. City Docks, sewer 5' 6" x 6' 6". Drains the most densely populated part of the city. Area of the drain 355 acres.

No. 9. Jackson St. sewer 4' 10" x 4' 13". Drains an area of 281 acres.

No. 10. Freeman St. sewer 4' 0". Drains an area of 149 acres. Keanny.

No. 11. Johnston Ave., sewer 7' 0" x 3' 3". Drains 242 acres. East Newark.

No. 12. Central Ave., 4' 0" x 2' 8". Drains an area of 859 acres. Harrison.

No. 13. Harrison Ave., Sewer 4' 0" x 2' 8". Drains an area of 106 acres.

The samples were taken from the discharge of these sewers on November 13th and 14th, 1907, and for the most part in the afternoon or near noon. The percentage saturation in dissolved oxygen of these samples, in the order given above was as follows:—70, 45, 35, 2, 42, 47, 73, 57, 26, 17, 28, 10, 7.

These samples so far as being influenced by bank water were collected, to the best of my knowledge and belief, at low water.

Q. Who collected those samples that were subjected to these chemical analyses to determine the oxygen contents?

A. They were collected to the best of my recollection and I think I am correct, by Charles F. Breitzke.

Q. Who employed Mr. Breitzke?

A. He was an assistant in the office of Hering and Fuller.

Q. Who made the chemical analyses?

A. He did on the ground.

3632 Q. How near the out fall were the samples taken?

A. His instructions were to take them at the first manhole after leaving the river.

Q. The first manhole after leaving the river?

A. Yes, sir. He located the outlet and then walked back on the line of the sewer until he came to his manhole.

Q. Then if I understand you right these samples were not taken from the river, they were taken from the sewer?

A. From the contributing sewers, yes, sir, to get an idea of the character of the sewage that would ultimately enter the trunk sewer.

Q. What part of the work did you contribute at that time?

A. This was the time when I was directing the whole investigation, and when I periodically went out on the shed myself and checked up the results of investigations made by my assistants.

Q. In some of the samples of sewage collected as you have described you found as high as 70 per cent oxygen contents?

A. 73.

Q. 73?

A. Yes, sir.

Q. You also found 70 in a sample or some samples?

A. Yes, sir.

Q. The lowest of the determinations being 2 per cent and the highest 73 per cent; is that right?

A. That is correct.

Q. You made none of those oxygen determinations yourself, did you?

A. No, sir, I made none.

Q. Were any samples taken under your direction at that time from any part of the Passaic River?

3633 A. No, sir. For the purpose of determining the amount of dissolved oxygen in the Passaic River, we did not think it was necessary.

Q. Did you expect that it would be higher or lower than in the sewers?

A. We knew that it would be lower.

Q. So that the sewers discharging into the Passaic River have a refreshing action on the Passaic River?

A. I think unquestionably, as discharged, that they have.

Q. They had in 1907, and do they still exercise that beneficial influence?

A. I think they do temporarily, until the low velocities permit the heavy matters to deposit on the bed on the stream there to be later putrified.

Q. What other work did you do at this stage in the Passaic Valley Sewerage Commissioners investigation or work, in 1907 or 1908?

A. That was all of the work I had charge of.

Q. Was there any bacteriological work done at that time under your direction?

A. No, sir.

Q. Was there any engineering work done by you or under your direction at that time?

A. Only such engineering work as you might put under the head of investigation as to trade wastes in the determination of the volume, but that is hardly engineering work inasmuch as it entails merely the measuring up of tanks from which these waters are discharged in order to get at the volume.

Q. What work did you do on the trade wastes at that time?

A. Investigation of the trade wastes problem was begun, as I have already testified, in the early part of 1907, and carried through, practically, the entire year, but the bulk of it was done in 3634 the first six months after the work was started. Our endeavor was to ascertain the volume of discharge of various objectionable trade wastes from the various establishments of the Passaic River discharging into it, and we considered that such information would prove valuable in not only aiding the engineer in charge of the design of the sewer in fixing the size of the sewer, but also would give us a clue as to what part, in the composition of the sewage was played by the trade wastes themselves. In prosecuting this investigation men were sent out from the office of Hering and Fuller bearing directions from me as what to do, and they visited the various

manufacturing establishments in the Passaic Valley water shed as would be likely to have objectionable trade wastes. A list of such establishments was previously prepared in the office from business and factory directories. In the case of Paterson we did not go into details for the reason that an investigation had only been made, in the years 1905 and 1906, by Mr. George C. Whipple, and his results had been reported in the reports of the City of Paterson.

Q. Do you mean Whipple or Hazen?

A. Whipple of Whipple and Hazen; his report was incorporated in Mr. Hazen's report.

In all the men from the office of Hering and Fuller visited two hundred and fifteen establishments, and of these one hundred and twenty-six, or about sixty per cent, were found to be important as regards offensive trade wastes, and full data were secured at these establishments relating to the location of the plant, the kind of industry, and the general character of the wastes and where and how they were discharged into the Passaic River, or whether they were discharged into sanitary sewers or otherwise. We got at the volume of discharge per day and per hour; in eighty-nine places the wastes were found to be insignificant as regards volume.

3635 Do you want the details of this, Doctor?

Q. I would like them very much, Mr. Johnson.

A. In Paterson sewage, the most northerly point the discharge is 2,700,000 gallons of trade wastes each day. Those are objectionable trade wastes, wastes that cannot be separated from the wastes and which enter the Passaic River without creating a nuisance. These wastes contained spent dye stuffs, soap, and considerable suspended matter.

Saddle River Township. The wastes from the dye stuffs at Rochelle Park amounted to 100,000 gallons per day, and contained spent dye, some soda some soap.

Passaic City. The wastes from woolen and worsted mills, breweries, paint works, etc., amounted to 1,432,000 per day. They contained spent dyes, spent acids and alkalis, yeast and soap.

Lodi Borough. A bleachery and dye works discharged 600,000 gallons of wastes daily. The discharge contained spent dyes and bleach and some sulphuric acid and soda.

Carstadt Borough. A small chemical plant discharged 2,000 gallons daily of waste products.

East Rutherford Borough. A bleachery at Carlton Hill, and a manufactory at Rutherford discharged each day 1,020,000 gallons of wastes, contained spent dyes, acids, gums, and starch, caustic soda, bleach, sand and powdered glass.

Nutley town. Two paper mills and one wool carding establishment, one oil works and a cutlery works, discharged about 1,094,000 gallons of wastes daily, containing pulp, lime, bleach and soap.

Belleville Township. A hat factory and four other establishments discharged 110,000 gallons of wastes daily, containing spent dyes, acids and fur.

Bloomfield Township. Here there was a paper mill, a hat fac-

tory, woolen mill, wall cover establishment, and two other establishments discharging 468,000 gallons of wastes daily, containing bleach, powder, some pulp, spent dyes, fur, traces of acid and a small amount of soap.

Glen Ridge. About 500 gallons of iron pickling.

Montclair. A paper coating works, discharged about 400 gallons daily of spent stuffs, chloride of lime, and copper sulphate. Five pounds of copper sulphate are used each day.

Orange. Ten hat factories and one brewery discharged each day 850,000 gallons of wastes, containing spent dye stuffs, traces of acids and considerable suspended matter.

East Orange City. Two establishments here discharged 17,500 gallons of wastes each day containing bleaching powder, caustic soda, soap and spent dyes, essentially.

Kearny. An abitor and linoleum works discharged daily a total of 160,000 gallons of wastes containing traces of acids, some lime and some hair.

East Newark. A thread Company discharged each day 212,000 gallons of wastes, containing spent dyes.

Harrison. A wire works and a battery discharged 155,000 gallons daily of wastes.

Newark City. The breweries, hat factories, and tanneries contribute over one half of the trade wastes of Newark and contain spent dyes, acids and soda, lime, salt, etc. The remaining wastes are varied in character.

Q. Did you make any computations with a view of determining the trade wastes from these two hundred and fifteen establishments which you examined in 1907?

A. Yes sir, we did, and they are as given above, the total being 12,878,000 gallons daily. Of this, it is understood that some 2,900,000 gallons come from communities which have withdrawn from the Passaic Valley Sewer District, leaving a net in 1907, of about 11,000,000 gallons daily.

3637 Q. In that computation, Mr. Johnson, did you withdraw the contribution of sewage and trade wastes of Bloomfield?

A. I did in this computation I have just made.

Q. Do you know whether or not, within two or three months, Bloomfield has applied for permission to participate in the Passaic Valley Trunk Sewer project?

A. I do not, but I have understood that the period of time given these various communities to signify their intention of coming in has expired.

Q. Was Bloomfield a member of the communities that were to enter into this project in 1907?

A. I so understood, yes sir.

Q. Which way did you understand it, that it was one of the communities?

A. I am quite certain it must have been, otherwise we would not have made these investigations.

Q. I understood you deducted Bloomfield from the gross amount?

A. In this statement which has just been made, placing the net

amount of trade wastes in 1907 at eleven million gallons, Bloomfield was deducted.

Q. And what was Bloomfield's contribution that should have been added?

A. 465,000 gallons daily.

Q. What did you estimate the contribution in sewage and trade wastes as being from the City of Newark?

A. The total amount of objectionable trade wastes there was estimated at 4,016,700 gallons daily.

Q. Who passed the question of whether the contribution was offensive or otherwise?

A. I did.

Q. What trade wastes and sewage did you regard as unobjectionable?

A. Water used for cooling in rolling mills, spent dyes in a highly diluted state, that is, the last wash, any wastes of that character that possess so little of the original trade wastes that their discharge into the stream would amount to nothing in the way of lowering its oxygen contents or adding any color to it.

Q. In your investigation of Pittsburgh, Pennsylvania, did you have occasion to take into consideration these very spent liquors, and their precipitating effect on the sewage discharged in the Monongahela River?

A. I guess that was the Alleghany, was it not.

Q. Well, take the Alleghany.

A. Yes sir.

Q. Are you familiar with the conditions in the Monongahela?

A. Yes sir.

Q. Have they not the gravest problems arising from these spent liquors?

A. It is certainly no simple problem, it is a serious one. But is as much as that is a mining country, an iron and steel country, if they eliminated these trade wastes they cut off their own head.

Q. Yet the water is fairly clear after those spent liquors are discharged into it, is it not?

A. It is fairly clear for the reason that they exert at the point of discharge a precipitating effect.

Q. And particularly of colloidal matter?

A. That is very true, but the fact remains that the amount of pollution entering the Alleghany River, above Pittsburgh, that brings about this precipitation of colloidal matters is so much out of proportion to this proposition here that it is worthy of no consideration. So much of these wastes enter that stream there as to occasionally render it green or blue or brown, according to the stage of oxidation in which the iron compounds are as discharged.

Q. What ill effect do spent liquors exercise on waters that are polluted by sewage?

A. Water that contains a great deal of spent dye, if out of proportion, will impart a color to the sewage; sewage that contains hair, or other suspended matter which easily sticks to the side of the sewer will cause clogging, and reduce the capacity of it. The same is

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true of grease. But it is a rule that is almost always adopted, to compel the owners of these industrial establishments to install at their own works purification devices, screens, small tanks and other things whose object it is to remove these matters before the sewage is allowed to discharge into the city sewers. The same thing would be true here. There is nothing unreasonable about it.

In making an investigation of this kind at Reading, Pennsylvania, we called the attention of the owners of certain hat factories there, to the fact that they were discharging large quantities of hair, fur, into the sewers, which were clogging them up; by putting in suitable screens and traps they recovered a great deal of this fur and actually derived a profit from it, so that we got thanked ultimately where we were thoroughly condemned in the first place. The same would be true here.

Q. Have they installed any such purification schemes for wastes known as spent liquors either on the Monongahela or the Alleghany?

A. I think not, no.

Q. Have they installed any such plants at any of the factories along the Passaic, where they discharged spent liquors?

A. Do you refer to spent dyes or spent liquors of any sort?

Q. Both.

A. Yes, sir, they have. With regard to Paterson I should have to look up the details of Mr. Whipple's investigation. I do not know whether that report is in the evidence or not; if it is the data are there.

3640 Q. I should be glad to have it in evidence if Mr. Riker agrees to it.

Mr. Riker: I will consider it, Doctor.

The Witness: At Rochelle Park the dye works discharge 100,000 gallons a day of spent dyes and wash water into the Saddle River, during six days of the week. Before reaching the river the waste passes through an unlined settling basin.

Q. Will sedimentation remove spent liquors, either the acids or the alkali that you have been describing?

A. If they are in proper combination, yes sir.

Q. What combination would they have to be in?

A. An acid with an alkali sometimes will form a coagulant and if it has the proper base it is conceivable you would get some precipitation in that way.

Q. Are you speaking theoretically now?

A. No sir, I am speaking practically.

Q. Give us an illustration for the Passaic water shed where these acids and alkali form precipitants by forming salts.

A. I could not call attention to any particular place, but it is perfectly conceivable. It is one of the integral parts of a mechanical filter process for filtering water and one in the integral parts of the chemical precipitation of sewage.

Q. Where did you say these purification processes were in operation now?

A. I was just running over them; the first one I have run across is at Rochelle Park.

Q. Is that in the Passaic Valley sewerage district?

A. That goes into the Saddle River; I think not. That has been withdrawn. Another is at Lodi, which has also been withdrawn; the wastes of a bleachery and dye works discharging 600,000
3641 gallons of wastes per day, they are passed first through settling basins before discharged into Saddle River or its tributaries.

Q. What is the object of a settling basin, to recover what?

A. Such suspended matters as the wastes may contain.

Q. What suspended matters do they contain, do you know?

A. I suppose the wastes from a bleachery would contain calcium chloride, calcium carbonate and possibly some solids from the dyes. I am not an expert on bleaching and dying but those are usual things. There might be fibrous matters probably and considerable dirt.

Q. And the object of the sedimentation is to recover this is it not?

A. It is to remove them before they are discharged into the stream. As a general proposition some people are philanthropically so inclined.

Q. Don't they use this sedimentation mass again?

A. I don't think they derive much profit from it.

Q. That is not the point; I asked you if they used them again.

A. I cannot say, I do not think so.

The wool carding establishment at Nutley discharges its wastes into a covered cesspool which overflows into the river but retains the suspended matters, and it is to be presumed skims off the grease; I do not pretend to know whether it does or not. The paper Mill wastes containing lime and bleaching powder and pulp are screened at Nutley before discharged.

Q. Will either of these last two methods you mentioned remove alkali or acids that are in the trade wastes; will either of the last two schemes you mentioned?

A. Oh no.

3642 Q. My question was originally directed to the one point as to what manufacturers had installed purification schemes for the removal of the spent liquors, these alkalise and acids wastes that you have told us of?

A. I do not think there are any such works in the Valley any where, because I think the quantities discharged are too small.

Q. Where they are large, as in the Pittsburgh district, are there any such projects or schemes for the removal of the spent liquors, either acid or alkaline trade wastes?

Mr. Riker: I enter an objection to the question in that it is not specific enough.

The Commissioner: Note the objection of counsel for the defendants.

A. I think not.

Q. Did you understand my question?

A. Yes sir. The plain facts are they allow these wastes to go direct into the river at the present time, for which they are removed from the waters used for public supply, at considerable expense.

Q. And the only way they could be removed would be by adding something that would form a salt and precipitate them is that so?

A. That is about right.

Q. In your investigation in 1907 and 1908 you accepted the report of Messrs. Whipple and Hazen to Paterson and took it without entering into any detailed investigations on your own part, is that right?

A. I selected from Mr. Whipple's data those wastes which were clearly objectionable; those wastes that were not objectionable I excluded. He recorded the total volume from Paterson City as being nearly 13,000,000 gallons a day in 1907, but the bulk of 3643 that was inoffensive and could be discharged into the Passaic River without nuisance.

Q. And you accepted it as it was in his report.

A. I won't say that I accepted the report as a whole.

Q. I say you accepted his details with regard to these trade wastes, as they were outlined in the report and discussed in the report?

Mr. Riker: The question is objected to on the ground that it contains an assumption; the witness has already said that he did not accept it altogether, but that he did accept certain features of it.

The Commissioner: Note the objection of counsel for the defendants.

A. That is generally true.

Q. As to the two hundred and fifteen establishments that you examined the trades wastes from in 1907 and 1908 and of which, if I recall right, you stated that one hundred and twenty-six, or sixty per cent, gave offensive trade wastes, who determined whether those trade wastes were offensive or not?

A. As soon as those two hundred and fifteen establishments were visited, or any part of them were visited, by myself or my assistants, the notes were brought to my office, and there studies and a decision arrived at, in the light of the data obtained as to the offensiveness or inoffensiveness of those trade wastes, and what portion of them was in one class and what portion was in another.

Q. How was that differentiation made as to the offensive and inoffensive trade wastes?

A. Of necessity it was made along lines which could not be set hard and fast. We naturally knew that the cooling water from a rolling mill of such wastes, would not be offensive; we knew that extremely dilute spent dyes would not be offensive those 3644 were separated out by gathering figures from the dye masters in each establishment and from the superintendants in the various works as to how much of this dye or how much of that dye, or how much of this substance or that was used during certain periods of any day or any week, and how that particular tank or

vat was discharged, and in that way it was possible through a process of analyses of the notes to eliminate large quantities of those wastes and to include other as offensive and objectionable.

Q. Where did you get the data that you passed upon?

A. These data were obtained by inspection that, is to say inspection on the part of my assistance and myself of the tanks in which most of these wastes were stored prior to their discharge, and by conversation with the chemists and superintendents of these various works as to the manner of their discharge, and what the discharge was composed of.

Q. Then you largely depended upon the statements made at the factories themselves as to the strength of dye wastes and spent liquor trade wastes?

A. That is true.

Q. In the computation for the volume of trade wastes and sewage did you exclude the Carlton Hill Bleachery?

A. It was included in the first complete statement and was not excluded in arriving at the estimate of 11,000,000 gallons, of total trade wastes for the day.

Q. And you still regard it as in the Passaic Valley Sewerage District?

A. It comes within the limits of East Rutherford Borough therefore it is considered within the limits.

Q. In 89 of these plants that you examined I think you have stated that the volume of trade wastes was insignificant am I right?

3645 A. Yes sir.

Q. As to the character of the trade wastes, how did you find it?

A. I could not say. If it had been regarded as important it would have been recorded because we got down as low as 400 gallons at Montclair, because of the presence of chloride of lime and copper sulphate, it is clear that these insignificant quantities of trade waste were not offensive.

Q. But you do not positively know do you, the character of the trade wastes in those eighty-nine establishments?

A. I do not, but I did at the time the elimination was made.

Q. And you do not find it recorded in your notes there?

A. It is not recorded except as I have already stated.

Q. What other work did you do for the Passaic Valley Sewerage Commissioners during 1907 and 1908 besides this computation of the volume of the trade wastes?

A. The other work that I did in the interests of the Passaic Valley Sewerage Commissioners was to conduct an experiment in New York Harbor to ascertain the probable mixing of the sewage of the Passaic Valley District with the waters of New York Harbor. A test was run on November 19, 1907, under my direction, and for this purpose thirty thousand gallons of fresh water heavily charged with an aniline color were pumped into the Bay at rates ranging from 1.8 to 2 cubic feet per second, at low water and a depth below the surface of Ten twenty, thirty, and forty feet. At the first two

depths the dyed water rose to the surface in a short period of time and was readily discernible; discharged at a depth of thirty or forty feet no trace of the dyed water was to be found. This test was run at low water and under conditions favorable to securing damaging proof against the feasibility of the pollution project. The discharge of this fresh water was in round number about one-eightieth of the rate of discharge such as would be anticipated in the case of six hundred thousand people.

I might call attention to the fact that similar experimented along this line were made by the Metropolitan Sewerage Commissioners and are contained on pages 457 et seq. 1910 report Metropolitan Commission, complainants' exhibit 143, to which I will refer later.

In making this test arrangements were concluded with the Merritt and Chapman Wrecking Company of New York City, whereby that Company was to furnish a pontoon containing thirty thousand gallons of fresh water, a tug boat with a necessary derrick and other appliances for towing the pontoon, a six inch centrifugal pump capable of discharging five hundred gallons per minute fifty feet below the surface water of the Bay, and a suitable quantity of six inch wrought iron discharge pipe. A launch was also provided to carry at least six persons.

On the morning of November 18th, my assistant Mr. Charles F. Breizke was sent to Saulterville where the pontoon was being filled with fresh water and at intervals during the filling twenty pounds of dye (red R) secured from Messrs. H. A. Mertz and Company, New York City, were added to the water in concentrated aqueous solution as the pontoon was being filled. A good mixture was obtained in this way; the amount of dye used was two thirds of a pound for one thousand gallons of water.

A number of preliminary tests had been made at Jerome Park Reservoir with different dyes in order to find one that when mixed in aqueous solution, in the proportions of one part of dye to 12,445 parts of fresh water, would not diffuse through salt water more rapidly than would fresh water alone, nor stratify after mixing. The dye used was found to answer all the requirements and when diluted with one part in four million parts of water it imparted a bright red color to the same. The Government predictions on the day of the test indicated that low water would occur at Robbins Reef Light at twelve forty-five P. M. Observations were made by the United States Coast Survey during 1858 and 1859, (See appendix 8 pages 1 to 9, Report of the Superintendent U. S. Coast survey) showed that at the time of low water at Robbins Reef Light slack water occurred at the bottom some two or three hours before it occurred at the surface. By means of submerged floats the following notes were recorded as to direction and the approximate strength of the current at the surface and near the bottom on the day of the test above mentioned. The depth of the water was about fifty feet.

Current Observations at Robbins Reef Light.

1:00 P. M.	Surface	South	3 ft. per second
	Bottom		Strong
1:15 P. M.	Surface	"	275 ft. per second
	Bottom		Strong
1:30 P. M.	Surface	"	125 ft. per second
	Bottom		Slight
1:40 P. M.	Surface	"	100 ft. per second
	Bottom		Very slight
2:00 P. M.	Surface	"	0.75 ft. per second
2:15 P. M.	Surface	"	Slight
2:30 P. M.	"	"	Slack
2:40 P. M.	"	North	Slight
	Bottom		
3:20 P. M.	Surface	"	1.0 ft. per second
3:30 P. M.	"	"	1.0 ft. " "

3648 Four tests in all were made during which the dyed water was discharged at depths of ten, twenty, thirty and forty feet respectively, below the surface.

The results obtained were as follows:

Test No. 1. From 1:40 to 1:56 P. M. 12,000 gallons of the dyed water were pumped into the Bay and discharged at a depth of forty feet at the rate of 1.8 cubic feet per second. The field lying south of the point of discharge and approximately five eighths of a mile long and half a mile wide was thoroughly inspected with the launch for three quarters of an hour, but no trace of the dyed water could be found. The current at the surface was southward with a velocity of about — foot per second. At the bottom there was a very slight current toward the south.

Test No. 2. From 2:35 to 2:41 P. M. 5,400 gallons of dyed water were pumped into the Bay and discharged at a depth of ten feet below the surface at a rate of 2 cubic feet per second. Color was detected at the surface 20 feet from the point of discharge two minutes after beginning the color was strong, and spread out in a streak toward the north 500 feet long. The color disappeared 15 minutes after the pumping ceased.

Test No. 3. From 3:00 to 3:06 P. M. 5,000 gallons of dyed water were pumped into the Bay and discharged twenty feet below the surface at the rate of 1.9 feet per second. Color first appeared fifty feet north from the point of discharge and at about five minutes after pumping it ceased. The color was slight, covered but a small area and disappeared quickly.

Test No. 4. From 3:18 to 3:24 P. M. 5,400 Gallons of dyed water were pumped into the Bay and discharged thirty feet below the surface at the rate of two cubic feet per second. The field in
3649 the neighborhood of the pontoon was sharply watched for half an hour but no color was detected except when pumping ceased owing to the pump drawing air, when bubbles of air brought up colored water to the surface around the pipe.

The above test showed, when dyed fresh water in quantities of 5,000 to 12,000 gallons are discharged within a few minutes into slow currents of salt water having a chlorine content of about eight thousand five hundred parts per million (46% sea water), and when the discharge was from a pipe six inches in diameter at the rate of 1.8 to 2 cubic feet per second, that

1. When the point of discharge is ten feet below the surface, the fresh water rises to the top almost immediately and spreads out over a large area.

2. When the point of discharge is 20 feet below the surface the fresh water rises to the surface in about five minutes and covers only a small area.

3. When the point of discharge is thirty feet to forty feet below the surface it was impossible to detect the colored fresh water anywhere at the surface, although the average current was slight.

As it is proposed to discharge the sewage from the Passaic Valley District from multiple openings and in quantities about the same as used in the tests for opening it is expected that the resulting conditions will be similar to those of the tests.

At this point the taking of testimony on the part of the defendants was adjourned until Friday, the fourteenth day of 3650 February, at ten thirty A. M. at the offices of Messrs. Riker and Riker, Newark, New Jersey.

3651 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,

VS.

THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Taking of Testimony at the Offices of Messrs. Riker and Riker Newark, New Jersey, Friday, February 14th, 1913.

Before James D. Maher, Esq., Commissioner.

Appearances:

Thomas Carmody, Esq., Attorney General of the State of New York;

William A. McQuaid, Esq., Deputy Attorney General;

Dr. William J. O'Sullivan, Special Counsel for The People of the State of New York, Complainants.

Edmund Wilson, Esq., Attorney General of the State of New Jersey;

Robert H. McCarter, Esq., Of Counsel for the State of New Jersey;

Adrian Riker, Esq., Of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

GEORGE A. JOHNSON resumes the stand, for further cross examination by Dr. O'Sullivan.

Q. Please continue from where you left off, yesterday.

3652 A. From these tests the inference may be drawn that fresh water sewage discharged as proposed through outlets,

some 150 in number, and located at a depth of 40 feet or more below the surface, will undergo a sufficiently complete diffusion in the waters of New York Bay so as not to raise to the surface in objectionable quantity, if at all and rarely, if at all, in visible quantities.

Among those present to witness these tests, were W. S. Ackerman, member of the Passaic Valley Sewerage Commission, Mr. Rudolph Hering, of Hering and Fuller, Mr. Wm. B. Fuller, the witness who conducted the test and his assistant, Mr. Charles F. Breitzke.

I have already referred to similar tests of this nature which have been made by the Metropolitan Sewerage Commission. The results of these experiments are recorded in the 1910 report of the Metropolitan Sewerage Commission, complainants' exhibit No. 143. The manner in which these tests were conducted and the results obtained, appear on pages 457-460. Under the heading experiments on the assent and diffusion of one liquid on another the following statements are made:

"A number of experiments were made by the Metropolitan — Commission to obtain practical information concerning the circumstances under which sewerage would and would not diffuse in harbor water. In general the method used in making these experiments were as follows: The water of sewage to be discharged was strongly colored with a dye; the discharge was then regulated to take place in a continuous stream under prearranged conditions as to velocity and volume beneath the surface of water with which it was to diffuse. The discharging current having been made visible by the dye it only remained to study the volume of diffusion by observing the colored water.

"After many tests two dyes, one known as uranine and the 3653 other special scarlet were selected; the uranine a sodium salt of fluorescein was found to be particularly suitable. This dye could be detected by sight in dilutions of one to thirty million parts of water. When a bucket full of dyed sewage was thrown upon the surface of the harbor it could be seen at a distance of a quarter of a mile; it might remain visible for 20 minutes or more.

"The quantities of colored water or sewage discharged varied between 300 gallons and 56,000 gallons according to the requirements of the experiment. The harbored water varied somewhat in salinity it usually contained about 25% land water and 75% sea water. The current into which the water or sewage was discharged, varied from a little less than 1 foot per second to 3 feet per second. Most of the large scale experiments were carried on near Robbins Reef in Upper New York Bay * * * "Each experiment was carefully and fully recorded with the inferences and opinions which had seemed safe to draw from the results * * * "the experiments on the largest scale were made with boat loads of dyed water—of dyed sewage. The dyed water was contained in casks of several hundred gallons capacity. Three of these casks were located upon the Commissioners' floating laboratory and connected with a steam pump which was capable of discharging the dye through suitable holes at any required depth * * * "the total amount of experiments made was 103, of these 66 were on a large scale."

Certain of the facts and opinions drawn from the experiments are recorded in the report on page 459 and among some of those appear the following:

"Sewage when discharged into sea water rises in a mass unless intermixed through the mechanical action of current.

"When sewage is discharged through an orifice into and beneath the surface of a quiet body of water, currents are set up in the latter which help produce an intermixture between the two fluids.

3654 The force of these currents varies directly with the velocity of the discharging currents and the volume of discharge.

"Of the 66 large scale experiment about one half were successful in showing the conditions which would be avoided in discharging the sewage beneath the surface of the harbor water. In 29 cases the sewage came at once to the surface; in 31 cases no effect was visible; in 6 cases the result was doubtful. The sewage was discharged at depths varying between 5 and 62 feet below the surface of the water. In one case at Robbins Reef, when 600 gallons of water were discharged at a depth of 40 feet into a current of 1 foot per second, it came to the surface. In another instance when 15,600 gallons were discharged at the same place and under what seemed to be a similar condition, it did not appear at the surface."

Details of the above experiments made by the Metropolitan Sewerage Commission are not given in the report. It might be inferred that the result of the large scale experiments were favorable to the discharge of sewage from the Passaic Valley Trunk Sewer as stipulated, in view of the result of the experiment conducted by me and already referred to above.

Q. Who was present Mr. Johnson during the experiments that you describe with the red R dye?

— Mr. Rudolph Hering, Mr. Wm. B. Fuller, Mr. William B. Ackerman, Mr. Charles F. Brietzke and myself.

Q. Were you working under the direction of Mr. Fuller and Mr. Hering at the time you conducted, in the manner in which you have testified, these experiments?

A. I hardly think you could call it that, for this reason, that this test was planned and executed under my immediate direction. They were there to observe the results. The description of the tests as previously given by me is taken almost verbatim from my report of those tests, made to Mr. Hering.

3655 — Did Messrs. Hering and Fuller compile a report as the result of your report to them and of the other investigations made relative to the trade wastes of the Passaic Valley that were being discharged into the Passaic River?

A. They did.

Q. Was that report ever published?

A. In part.

Q. Where was it published?

A. In the report of the Passaic Valley Sewerage Commission, the date I have forgotten.

Q. Was it 1908?

A. 1908 yes.

Q. I show you what purports to be a report of the Passaic Valley Sewerage Commissioners to the municipalities lying in whole or in part with the Passaic Valley Sewerage district, dated 1908 and ask if that is the report in which portions of the matter that you have testified to *where* recorded?

A. It is.

Q. From the investigations conducted by yourself under the direction and with the co-operation of Messrs. Hering and Fuller were any conclusions reached relative to the discharge of the Passaic Valley sewage that were not included in this report of 1908 which I have just shown you?

Mr. Riker: Conclusions by whom Doctor?

Dr O'Sullivan: By the people I have just mentioned.

A. It is my understanding that the report you have just shown me was prepared largely by the chief engineer of the Passaic Valley Sewerage Commissioners, Mr. Edlow W. Harrison.

Q. Did Mr. Harrison pass upon what portion of the Hering and Fuller report should be included in the report of the Passaic Valley Sewerage Commissioners dated 1908?

3656 A. That I do not know.

Q. Have you got the full report of Messrs. Hering and Fuller on the conditions relating to the discharge of sewage or the condition in which the sewage would reach the pumping station at or near the Newark meadows?

A. I have what I believe to be a copy of the report of Messrs. Hering and Fuller to the Passaic Valley Sewerage Commissioners, dated December 31, 1907, which report pays particular attention to construction features and features of design and cost of operation and maintenance of the proposed project and among the appendices I find a digest of the report prepared by me on the trade wastes investigation and on the composition of the sewage of the Passaic Valley District; also a practically complete copy of my report to Mr. Hering on the test before referred to, of dispersion of dyed fresh water in New York Bay. In this report I find no predictions as to the probable compositions of the sewage of the district as discharged below Newark.

Q. Do you find in that report of Hering and Fuller any conclusions from such investigations as were made to the condition in which the sewage would reach the pumping station?

A. I find no statement in this report bearing on that phase of the matter.

Q. Did they reach any conclusions which you knew, of relative to the condition in which the sewage would reach the pumping station?

Mr. Riker: The question is objected to on the ground that it is irrelevant and immaterial, and if the conclusions are relative to the inquiry they should be proved in another way.

The Commissioner: Note the objection of counsel for the defendants.

A. It is my belief that such conditions were formed as the result

3657 of many conferences between the various members and employees of the firm of Hering and Fuller; but these conditions were not set down in the report as they were considered to be immaterial.

Q. Did you reach any conclusions yourself from your observations of such work as you did to determine the character of the sewage as to what the composition of the sewage would be when it reached the pumping station?

A. I have already testified as to my conclusion on that line.

Q. In what condition did you expect it to reach the pumping station?

A. My conclusion in general with regard to the probable composition of the sewage discharged by the Passaic Valley Trunk Sewer at the treatment works below Newark, were as follows: That the sewage will probably not, as a rule, contain large volumes of offensive odors. It may at times be devoid of dissolved oxygen, but for most of the time would probably contain a small amount of dissolved oxygen. The reason which I have previously given in my testimony, are that the rapid velocity of flow of the sewage in the trunk sewer, and with the sewers contributing sewage to the main trunk sewer, which contributing sewage will, much of the time, contain material quantities of dissolved oxygen, and because of the infiltration of ground water into the trunk sewer which ground water will contain material quantities of dissolved oxygen, the sewage discharged below Newark will not have been afforded favorable opportunity to become septic as would be the case if it were devoid of dissolved oxygen throughout practically the entire length of the trunk sewer, and if the velocity in the trunk sewer were sufficiently low to allow of the deposit therein of quantities of suspended organic matters which would later undergo putrefaction through agencies of bacterial activities?

3658 Q. When did you reach that conclusion, what year?

A. In general it has been my belief from the beginning.

Q. Dating from when?

A. 1907.

Q. Did you express that opinion to Messrs. Hering and Fuller in 1907?

Mr. Riker: The question is objected to on the ground that if conversation is the proper subject of an inquiry the witness should be appraised of the time and place and the general character of the conversation.

The Commissioner: Note the objection of counsel for the defendants.

Dr. O'Sullivan: Complainants' counsel presses the question because this is not relative to a conversation but a report made by an employee to his superiors and in relation to the subject matter of a report made by them to the Passaic Valley Sewerage Commissioners which this witness has testified was never published excepting in part.

Mr. Riker: The question is now objected to on the statement of counsel concerning the question on the ground that such a question

is only admissible for the purpose of contradiction of this witness and is not proper in form for that purpose.

The Commissioner: Note the further objection of counsel for the defendant.

A. I think that, in general, I did.

Q. Was that embodied in a conclusion reached in the report of December 31st, 1907, by Messrs. Hering and Fuller and submitted to the Passaic Valley Sewerage Commissioners?

A. It was not, as before stated.

3659 Q. Will you look at the report which you have stated you believe is a copy of the report of Messrs. Hering and Fuller dated, December 31, 1907, and see if you find the conclusions that I will now read to you in that report:

"The indications are under present conditions that the sewage as it reaches the pumping station on Newark meadows will normally be devoid of dissolved oxygen. From the foregoing result it seems quite plain that even though the discharge of the several outlets contribute considerable dissolved oxygen, this will be quite speedily absorbed. In its travel of 20 miles in some ten hours it will become septic, but the more or less constant addition along the route of sewage containing dissolved oxygen will retard rapid putrefaction. As received at the pumping station, the sewage will doubtless be septic and blackened."

Q. Will you see if you can find what I have just read to you now as the conclusions of Messrs. Hering and Fuller and which was not included in the Passaic Valley Sewerage Commissioners' report of 1908?

Mr. Riker: The question is objected to as immaterial and irrelevant to this inquiry and on the further ground that the original report, if it is desired to have testimony from it, should be called for and produced and proved in regular course.

The Commissioner: Note the objection of counsel for the defendant.

A. No such statement appears in my copy of what I believe to be the report of Hering and Fuller to the Passaic Valley Sewerage Commissioners, dated December 31, 1907.

Q. Have you got the complete report there, Mr. Johnson?

A. I have yes, sir.

Q. Will you permit me to offer it in evidence as the complete report?

3660 Mr. Riker: You will not offer it in evidence with my consent; if you want the report call for it.

Q. You are quite positive that you have the full report there of Hering and Fuller of December 31, 1907?

A. This report is marked on the cover "extra copy"; it has the typical binder used in the office of Hering and Fuller at the time I was connected with that firm; it is addressed to The Passaic Valley Sewerage Commissioners Prudential Bldg., Newark, N. J. and is dated December 31, 1907.

Q. How many pages are there in the copy you are consulting and testifying from now, Mr. Johnson?

A. The report proper is of 37 pages; there are 5 appendices, making the total number of pages 72.

Q. In 1907 how long was it estimated that sewage would take to reach the pumping station from Paterson?

Mr. Riker: The question is objected to on the ground that it does not appear whose estimate is called for by the question.

The Commissioner: Note the objection of counsel for the defendants.

A. I presume somewhere in this report there are data from which the time you refer to could be determined; I am unable to put my hand on it now, but I find on page 66 of this report the approximate distance from the West 18th St. outfall at Paterson, which each contributing sewer along the line of the trunk sewer is from the point mentioned. No reference is made to the velocity of flow in this sewer, in this table, so I am unable to answer your question more definitely.

Q. Will you permit me to look, Mr. Johnson?

Mr. Riker: There is no reason why you should Mr. Johnson. I recommend that you do not.

Q. What is your answer to my question?

A. On the advice of counsel I must refuse.

3661 Mr. Riker: Counsel for the defendant says that if counsel for the complainant desires to call for the original report, it will be produced, if we have it.

Dr. O'Sullivan: I make such a request, that the original report be produced.

Mr. Riker: Very well, we will see that you shall have it. This is not the original; at a later — I will examine the records of the Commission and find if they have the original report there.

Q. Is it your opinion that you have an exact copy of the original report in front of you now?

A. I am led to believe so because of the peculiar manner in which it is bound. But I have no knowledge of its being a precisely correct copy.

Q. Have you any reason to believe that any pages are missing from the report, from the copy which you now have in front of you, are there any pages missing, that you know of?

A. It is difficult for me to say for the reason that it is irregularly paged and not consecutively paged, each section and each appendix being paged by itself; furthermore none of the tables are paged.

Q. Who first suggested the dye tests and the particular dye that was used in experiments you have described?

A. I am unable to say, but the dye selected for the tests was my choice.

Q. Why did you choose red R as dye for these experiments?

A. I chose it after making careful studies of the power of diffusion of various dyes of this same general character.

These tests were made at the Jerome Park Reservoir Station, in 1907, in November, I think.

Q. What other dyes have you ever experimented with?

3662 A. In what manner?

Q. On these diffusion tests, any where at any time?

A. I could not say precisely but probably about half a dozen.

Q. Will you name them?

A. I cannot off hand. They all were obtained from the same source, H. A. Mertz and Company of New York City, and were all either red or yellow dyes.

Q. When you mentioned uranine special scarlet and flouresci and red R dye, did you ever work with any of those other dyes besides the red R dye which I have just mentioned?

A. As before stated I tested put several dyes at the Jerome Park Reservoir Station in 1907 and selected this one as giving the highest color in the greatest dilutions and as being a dye which diffused through a body of salt water no more rapidly than did fresh water itself?

Q. The experiments you conducted with this dye at the Jerome Park Reservoir, were in fresh water were they not?

A. Salt water.

Q. At the Jerome Park Reservoir?

A. At the station on Jerome Avenue.

Q. What is the chemical composition of red R dye?

A. I could not tell you.

Q. How is it effected by nitrites?

A. In such quantities as would be encountered in fresh water, or in salt water for that matter, I should think it would have practically no effect.

Q. What percentage of nitrite occurs in sea water normally? Can you answer my question without consulting a work on chemistry?

3663 A. I am not consulting a work on chemistry, I am endeavoring to get a published analyses of sea water, I presume, that is what you want. The contents of sea water in nitrites and in nitrates, as a matter of fact in all constituents, will vary with the composition of that particular sea water.

Q. Taking the Atlantic ocean sea water two miles from the shore?

Mr. Riker: The question is objected to on the ground that it does not appear that this witness has examined that water taken from the point mentioned, and the question has no foundation whatever.

The Commissioner: Note the objection of counsel for the defendant.

A. I could not tell without consulting, (interrupted).

Q. How do carbonates in salt water affect red R dye in aqueous fresh water solution?

A. I have no knowledge.

Q. How will the sulphates in salt water affect red R dye in fresh water solution?

A. That I don't know.

Q. How will the putrifiactive gases that are evolved from an-erobic decompositions of sludge deposits on the harbor bottom, affect red R dye when in its immediate vicinity?

A. I have no knowledge on that point.

Q. Do you know what the chemical composition of fluoresceim is?

A. I have already read in into the testimony, I do not know personally, no.

Q. Do you know what the chemical composition of special scarlet or uranine is?

A. I do not.

Q. Do you know whether they are affected by the bleaching action of the components evolved from pollution and putrifiactive agents in brackish water?

3664 A. Inferentially I should say no, for the reason that these dyes are always used in such tests as these and in attempting to trace polluted matter from a known source of pollution to running streams or other bodies of water.

Q. In the tests which you describe with the red R dye you found coloration of the water where the injection into the current was at only a few feet from the surface; is that right?

A. Down to a depth of 20 feet below the surface, according to our experiments, these heavily dyed fresh waters were observed to rise to the surface; below that depth they could not be detected.

Q. Is an an-erobic action most active below or above the 20 feet depth, you performed the experiment in, where you discovered the discoloration of the harbor water?

A. It appears perfectly clear to me that an an-erobic action is restricted almost entirely to the deposits on the harbor bottom and that in the overlying strata of water no such actions are going on.

Q. What is the oxygen contents in the 2 or 3 feet of water overlying these harbor deposits?

A. From such knowledge as I have of work which has been done on this point, I assume, basing my assumption very largely on the findings of the Metropolitan Sewerage Commission, that, excepting at the bottom of the harbor there is very little difference in the oxygen contents of the overlying waters at any depth, which explains in a large measure the reason for my last answer.

Q. What are the products of an-erobic decomposition evolved from these harbor deposits?

A. I believe that they are legion; among others may be mentioned iron sulphate, sulphuretted hydrogen, marsh gas, etc.

3665 Q. How will hydrogen sulphite affect red R dye when in solution in fresh water?

A. I have already stated I have no knowledge on this point but in view of what I have already testified to with regard to an-erobic action being confined to the bottom layer, as a normal proposition, I do not believe that hydrogen sulphide is present in the overlying strata of water in quantities sufficient to affect the color of the red R dye, referring particularly to its oxidizability, although I have no positive evidence on this point.

Q. What volume of hydrogen sulphide is necessary to bleach red R dye?

A. I don't know.

Q. Or interfere with its color in any way?

A. I don't know.

Q. Have you made any tests to determine the quantity and solubility of hydrogen sulphide in brackish waters?

A. No sir.

Q. How will methane affect red R dye when in fresh water solution meeting it in the presence of brackish water?

A. I don't know.

Q. Do you know whether nitrogen and hydrogen, these gases, are given off in brackish water as the product of an-erobic decomposition?

A. I presume there is little question of that; I think such is the case.

Q. Do you know whether the element sulphur itself is evolved from sulphuric oxide as the product of an-erobic decomposition?

A. It is undoubtedly evolved.

Q. And that is a strong bleaching agent is it not?

A. I presume as such it is, without having first gone into combination with some other substance or gas.

3666 Q. And you have conducted no experiment to determine these factors that at great depth might interfere with the result of your experimental works in that particular which you have testified to?

A. No sir.

Q. What was the depth of the experiment in which you failed to discover color?

A. The two depths below 30 feet.

Q. Which was the deepest?

A. 40 feet.

Q. How near to the deposits from the mouth of the 6 inch pipe through which you discharged the red R watery solution?

Mr. Riker: The question is objected to on the ground that it does not appear in the evidence of this witness or elsewhere that there were any deposits nor what the deposits were.

The Commissioner: Note the objection of counsel for the defendants.

A. The total depth of water at the point where the tests were conducted was between 60 and 70 feet; the distance from the bottom of the harbor to the mouth of the discharge pipe during the tests where the dyed water was discharged at the lowest depths beneath the surface was therefore between 20 and 40 feet.

Q. How deep, was the water at the sides of the channel where that great depth exists?

A. I would not attempt to say in precise terms, but it ranges from a maximum depth of the channel at that point, according to my best recollection, of 70 feet, to about 25 feet or less, on the submerged banks of the channel?

Q. In which direction did the six inch pipe through which you made the discharge, point?

A. Vertically downward.

Q. Did it face either to the north, south, east or west?

3667 A. It did not.

Q. How near to either bank of the channel were you when you made the discharge?

A. The point of discharge was near the western edge of the main channel and about $\frac{3}{8}$ of a mile northeast of Robbins Reef light.

Q. How did you determine the location of the boat?

A. We gave directions to the captain of the tug boat to anchor the pontoon at that point, and when we went out to the pontoon we observed that it was about in the location mentioned. No precise determinations were made to absolutely fix the exact point.

Q. Do you mean to tell me Mr. Johnson that the boats you were operating in with these experiments were anchored in the main ship channel?

A. Just off it.

Q. How far off of it, that is what I am trying to get at?

A. The tug boat itself was anchored on the bank of the channel; the pontoon was suspended out over it.

Q. How near to the bank and how far from the boat in which you were conducting these experiments?

A. The pontoon was attached to the tug boat, therefore the location would be near the edge of the channel.

Q. How near?

A. I could not say beyond what I have already stated that it was near the edge of the channel.

Q. Within a few feet?

A. Within a few feet.

Q. And the edges of the channel are largely composed of these sewage deposits are they not?

A. I am not in a position to state of my own knowledge.

Q. Did you think it material to take that fact into consideration in conducting these experiments?

3668 A. There were so many data on record in the reports of the Metropolitan Sewerage Commission, that we felt inclined to take their data as being true statements of the facts.

Q. Would any of their data enable you to locate a boat at a fixed point in the channel, or on the banks of the channel in upper New York Bay?

A. I presume there may be such data in their reports, but I do not recall any such at this time.

Q. How did they make their locations, for harbor points that they would plot on maps as scenes or sites for experimental work?

A. I presume those facts are stated in their reports, I don't know.

Q. How would you make a location in New York Upper harbor so as to identify it later on a map?

Mr. Riker: The question is objected to on the ground that the witness is not an expert, and does not profess to be, on surveying

and that it is immaterial and irrelevant how he would do it, the only possible relevant question being what was actually done.

The Commissioner: Note the objection of counsel for the defendants.

Dr. O'Sullivan: The question is pressed by complainants' counsel because the witness has stated that he depended upon the mariner who located the boat *the boat* on the edge of the ship channel.

Mr. Riker: I do not understand the witness has said that; he has stated the condition of things, but not as counsel for the *defendant* has stated.

3669 A. The only attempts that were made to establish the approximate points at which these experiments were made were as already stated; we made a trip in a launch from the tug boat around or near the Robbins Reef light, observed it from all points and it was the consensus of opinion on the part of those present that this location was approximately as stated in the previous testimony. We made such soundings as satisfied us as to the depth of the water at this point and at points relatively near it.

Q. Who made the soundings?

A. Mr. Brietzke and myself.

Q. Have you recorded those soundings in the reports you made of those experiments?

A. I have not in this testimony.

Q. Are you depending on your memory now for the facts relating to the soundings?

A. Yes sir.

Q. What is the depth of water at Robbins Reef Light itself?

A. I never determined it.

Q. What is the depth of water within a quarter of a mile at Robbins Reef Light in either direction away from the channel?

A. If you desire those data I can obtain them for you in a few moments from authenticated records.

Q. Have you recorded the soundings in the report you made?

A. I think not. Those soundings were made incidental to the collection of certain samples of water at various depths at the time these experiments were going forward.

Q. Were all the tests that you have testified to made at the same point?

A. With the exception of such tests as we made at Jerome Park.

Q. Those in reference to the red R dye tests, were the tests made at the same point?

3670 A. As I have said, with the exception of such experiments on this same point as were carried on at Jerome Park.

Q. Those conducted at the harbor were at the same point?

A. They were.

Q. What was the condition of the tide?

A. Between the hours of 1:00 P. M. and 3:30 P. M. and it was during this period that the tests — made. The tide was flowing south, between the hours of 1:00 P. M. and 2:30 P. M. turning north at

the surface at 2:40 P. M. and continuing in that direction throughout the test.

Q. The flood began when?

A. It was noticeable at the surface at 2:40 P. M.

Q. How long did slack water last before the turn of the tide on that day?

A. At 2:15 P. M. the current at the surface was slight, in a southerly direction; at 2:30 P. M. the current was slack at the surface; at 2:40 P. M. the current was slightly in a northerly direction.

Q. At what hour did you make that deeper experiment?

A. At 3:18 to 3:24 test No. 4 was made and in this case the dyed water was discharged at a depth of 30 feet below the surface.

Q. What was the condition of the tide at that time—3:18 I think you said until 3:30?

A. It was in flood at the surface.

Q. How far did you go from where you discharged the colored dyes to seek its re-appearance?

A. About a mile.

Q. In what direction?

A. In the direction of the tide and—in both directions as a matter of fact. We scoured the field in all points radiating from the pontoon, the point of discharge.

Q. And that was at 3:30?

3671 A. Yes, sir.

Q. And you had flood at what time?

A. The tide turned north at 2:40 P. M. as I observed it at the surface.

Q. When you began these experiments you began on the ebb tide at 1:30?

A. That is right.

Q. Do you know anything about the phenomena of the under-current at that time in the main ship channel in New York's upper bay?

A. I do not, in precise terms of velocity in feet per second; we were, however, taking samples of water at different depths during all this period at various times and in this manner were able to ascertain whether the tide was strong at the bottom or otherwise. That has been recorded in my previous testimony in the form of a table headed: "Current observations at Robbins Reef Light."

Q. As to the current that obtained between 1:30 and 3:30 P. M. were there not two bodies of water moving in opposition directions just where you were experimenting?

A. That would be expected in view — observations that have repeatedly been made by the government officials and by the Metropolitan Sewerage Commission, but in this case I am unable to cast any definite light on that point for the reason that we merely recorded the intensity of the current at the bottom as "strong" or "slight" or "very slight" or "slack."

Q. What is the average velocity of the ebb in Upper New York Bay?

A. The data are somewhat conflicting on this point, but I can

refer you to observations made by the United States Coast Survey, to the report of the superintendent, dated 1873, page 129, in which the velocities of the tides off Robbins Reef are given as 3672 follows:

Velocities in Feet Per Second.

Point.	Tide.	Max.	Min.	Average.
Surface.....	{Flood	0.54	0.10	0.35
	{Ebb	2.13	0.82	1.36
12 feet below.....	{Flood	1.68	0.64	1.08
	{Ebb	2.57	0.54	1.67
48 feet below.....	{Flood	2.26	0.13	1.25
	{Ebb	0.69	0.20	0.53
Average.....	{Flood	1.49	0.29	
	{Ebb	1.80	0.52	

On page 155 of the 1910 report of the Metropolitan Sewerage Commission, those average velocities of flow on the ebb and the flood tide are given as follows—

Q. (Interrupting.) Before you give that I would like to ask you if the currents in any way changed in the main ship channel between 1907 and 1910, the dates concerning which you are about to read?

A. That is precisely the point I am coming to, Doctor.

It is observed here that the maximum velocity of the flow of the current on the ebb tide is 3.42 feet per second and on the flood tide 1.27 feet per second; mean velocities of flow of the current on the ebb tide are given as 2.07 feet per second and on the flood 1.61 feet per second. These last given data show figures even higher than the velocities observed by the government as previously recorded, so in answer to your question, it may be inferred that the 3673 velocities of the current near Robbins Reef have increased since 1873.

Q. The government velocities that you have just read were for what year?

A. I am unable to state that; there is merely recorded the fact that these observations were made by the United States Coast Survey and they are recorded in the report of the superintendent dated May 1873 (page 129) and presumable were made during the year 1872-3.

Q. Do you know whether or not the current velocities have been changed considerably between 1892 and 1907 when you made your observations, by any factors?

A. Not to my knowledge, no, sir.

Q. What is the distance from the Battery to Sandy Hook?

A. I can't say without measuring it.

Q. Will you say that the ebb currents in 1907 were more than a quarter of a mile per hour?

A. Yes, I should say they were considerably more than that.

Q. Have you, in the course of your investigation, consulted a

report by Colonel Black in 1909—William M. Black, Colonel Corps Engineers, chief engineers, office Department of the East, to the Adjutant General Department of the East at Governors Island, New York on June 1, 1909?

A. I saw the report when it came out and have a copy of it; I have consulted it to some extent.

Q. Colonel Black in that report, in the 11th paragraph, gives the distance between the Battery and Sandy Hook as $16\frac{1}{2}$ miles, and I quote his words now:—

“The mean velocity of the ebb current is about $\frac{1}{4}$ miles per hour.”

Q. Have you reason to doubt that?

A. The observations made by the Metropolitan Sewerage Commission referred to, indicate an average velocity of flow of the 3674 tidal stream of about $1\frac{1}{2}$ miles per hour.

Q. For what year was that?

A. I presume those were observations of 1909 for the reason that these data appear in the report of the Metropolitan Sewerage Commission (page 155) for 1910.

Q. Had anything occurred between 1907 and 1910 to either increase or diminish the current velocities that you know of?

A. I presume you refer to the dredging operations; it is possible that they may have to some extent affected the velocity.

Q. How did the opening of the Ambrose channel affect the velocities in the main ship channel if you know?

A. It is to be inferred that they would be liable to reduce these velocities but not to any material extent that would allow of the statement that the average velocity of the flow is $\frac{1}{4}$ of a mile per hour, in the face of the data given by the Metropolitan Sewerage Commission, above referred to, where the velocities are shown to average $1\frac{1}{2}$ miles per hour. The difference is too great to be accounted for in this manner.

Q. How does the Ambrose channel intersect the main ship channel in the upper Bay?

A. I could not tell you.

Q. Does it intersect it in Upper New York Bay?

A. I know nothing about it.

Q. What was the duration of the ebb flow, the average duration of the ebb flow in 1907, 1908 or 1909?

A. I don't know but I presume it was $6\frac{1}{4}$ hours, that is the usual period of either tide.

Q. That being so, why did you go north after you conducted that deep water experiment at 3:18 P. M.?

A. We made it a point not to leave any possibility uncovered therefore we went to improbable places as well as those we considered probable.

Q. Was that $6\frac{1}{4}$ hours from 1:30 P. M. when the ebb began?

3675 A. Every ebb and every flood tide is supposed to be $6\frac{1}{4}$ hours in duration.

Q. And in this particular instance you had flood in less than that time, did you not?

A. We did not cover the full tide.

Q. What I want to know is, after making your injection during the ebb, why you went north to see if the color appeared on the surface?

A. We covered an hour and a half of one ebb tide, and about an hour of a flood tide. We therefore had no knowledge of the precise nature of the velocity of flow of the underlying strata. We wanted to be sure that we did not miss it, if it happened to be carried north by some other current.

Q. Did you make any attempt to determine the velocity of the bottom current on that occasion?

A. Nothing further than observing the direction in which the cord holding a sample bottle was thrown off the perpendicular, and observing the intensity of the pull on the cord.

Q. Do you know whether that had gone down deep enough to reach the under-run?

A. We know it went down 60 or 70 feet.

Q. Did you know how deep the under current was operating?

A. No.

Q. So that the dye may have been carried in a direction different than the one in which you looked for it?

A. If it did and reached the surface, it reached it outside of a radius of a mile from the point of discharge, because we were passing over that territory as fast as a light launch with a high power engine, could carry us.

Q. I understood you went north after you made the injection of this colored fluid?

Mr. Riker: The question is objected to on the ground that there is involved in the question a statement by counsel that does not accord with the witness's testimony; he stated they went in every direction.

The Commissioner: Note the objection of counsel for the defendants.

A. I can only repeat that we covered the entire field, north, south, east and all directions.

Q. And in what period of time?

A. We were constantly in the launch, coming back at the time when each experiment was started and starting a new one.

Q. If that injected color fluid had been injected into the under-run where would you expect to find it on an ebb current?

A. We didn't expect to find it.

Q. In what direction did you look for it?

A. In all directions.

Q. Did you travel in a circle or at various right angles to the point where you made the injection?

A. We did not lay those lines out with extreme precision.

Q. If it had been injected into the under-run where would you expect it to arise and appear on the surface?

A. That would entirely depend on the depth at which it was dis-

charged, the velocity of the current and the other features intimately related to that general phase of the problem.

Q. If it were injected into the under-run might it not reach the Battery before it came to the surface?

A. I could not tell.

Q. Did you go as far as the Battery to look for it?

A. I think not; we might have if it was within the radius of a mile.

Q. Do you remember now whether you did or did not go as far as the Battery?

A. I think we did not.

3677 Q. You mentioned something yesterday about submerged floats how were they constructed?

A. I do not recall where that testimony appeared, but I do remember the statement was made, I find it now. Those floats were used by the United States Coast Survey and are referred to in connection to the observations made by that survey during 1858 and 1859 and are recorded in appendix 8, pages 1 to 9, report of the Superintendent U. S. Coast Survey.

Q. Did you use any submerged floats on the occasion when you made those experiments with the red R dye?

A. We used no floats with the exception of the sample bottles to which I have already referred.

Q. Who put the red R dye in the water that was used for the experiment?

A. Mr. Charles S. Breitzke.

Q. Did you see him do it?

A. No sir.

Q. Do you know what the strength of the solution of this red R dye is?

A. I have known Mr. Breitzke for a great many years and I have always observed that he followed instructions. I purchased the dye myself and gave it to him; it was not exceedingly valuable but I don't believe he would have thrown it away; I saw the dyed water after he had prepared it, in the pontoon, as did Mr. Hering and Mr. Fuller, and I am satisfied that it was of the strength mentioned. It had the color of blood.

Q. But you did not see the mixture you said until after it was in the pontoon?

A. No sir, that has already been recorded in the testimony.

Q. Do you think the experiments you performed are in any way comparable with the continuous discharge of sewage from such a large outlet, or series of outlets, as is contemplated in the Passaic Valley Sewerage project?

3678 A. I do.

Q. The large experiment was with 500 gallons per minute, that was the rate, was it not?

A. I believe that was the figure.

Q. And that would equal how many gallons in twenty-four hours?

A. 720,000.

Q. What is the full or maximum capacity of the proposed discharge from the Passaic Valley Sewage?

A. I have not looked into that actively for some years, but I believe it is designed to care for an ultimate average sewer flow of 240,000,000 and a maximum flow of 360,000,000 gallons per day.

Q. Apart from the oxygen determination made of the sewage and these experiments and the mode of examining the trade wastes that you have described, what other work did you do in relation to the Passaic Valley Trunk Sewer project?

A. I spent several weeks at the Jerome Park Station making determinations in order to cast some light on the rapidity and completeness with which fresh water, charged with fine clay, water colored with alinine dyes, and fresh water alone, would mix with salt water. These tests were carried on in the latter part of 1907.

Q. Where is the Jerome Park Reservoir Station that you mentioned?

A. At the southern end of the existing Jerome Park Reservoir.

Q. In New York?

A. In New York City, yes sir.

Q. Did you hold any official relations with the municipality of New York at that time?

A. My firm were consulting engineers to the Department of Water, Gas and Electricity at that time, or had been a short time
3879 prior to that. These experiments, however, were carried on with devices owned by people other than officials of New York or citizens of New York.

Q. What other work did you do besides the experimental work you have just now alluded to?

A. I paid particular attention to various other phases among the more important of which might be mentioned the possible feasibility of purification of the sewage of the Passaic Valley district before its discharge.

Q. Did you make any chemical analyses?

A. No sir.

Q. Or bacteriological analyses of any kind?

A. Not that I remember.

Q. Or microscopical examination?

A. Not that I recall.

Q. What other work did you do in 1907 or since then in relation to the Passaic Valley Sewerage Commission's project for a trunk sewer?

A. I think I have mentioned all of the work that I did.

Q. I think in your direct testimony you stated that you had been recently active in examining some of the data submitted to you in relation to this trunk sewer project, am I right?

A. Yes sir you are in reference to the examination of the plans which are proposed for the treatment of the sewage of the district.

Q. Did you see all the plans and specifications of the Passaic Valley Trunk Sewerage Commissioners?

A. It is difficult for me to answer that because the plans are legion; I saw a great many.

Q. Who submitted them for your inspection or study?

A. Mr. William Gaven Taylor, principal assistant engineer.

Q. When had you seen the plans previous to that?

A. All of the plans that I had seen prior to that time were those prepared in the office of Hering and Fuller at the time I was connected with that firm.

Q. When did you see them there last, before severing your connection with that firm?

A. I saw them practically every time I opened the wrong drawer until I left the office.

Q. Were any changes made in those plans between 1907 and 1908 and the time of your seeing them now in the month of February 1913?

A. I presume there have been many changes made, there always are in any set of plans.

Q. Do you know whether there were or not?

A. No sir.

Q. Do you know whether there were very material changes made as to the caliber of the trunk sewer itself?

A. I am not positive.

Q. What is the length of the trunk sewer proposed to be?

A. To the best of my knowledge it is some twenty miles long at Newark; between Newark and the point of discharge the distance is some five or six miles.

Q. What is the average diameter of the intercepting sewer?

A. As now designed I am unable to state.

Q. I understand you saw those recent plans in this present month?

A. Yes sir, I did.

Q. The plans executed by Mr. Edlow Harrison and Mr. Taylor and completed in December 1910.

A. I believe that was the set I saw with some additions.

Q. What is the maximum capacity of the trunk sewer itself?

A. That I do not know, beyond what I have already testified to, that it was my understanding the capacity of the main trunk sewer was 360,000,000 gallons per day.

3681 Q. How many communities is it proposed to serve or is the sewer designed to serve?

A. At that time there were some twenty odd.

Q. Covering what drainage area?

A. I am unable to say.

Q. How many of the communities to be served by the Passaic Valley Sewer project are sewerage on the combined system?

Mr. Riker: Question objected to because it does not yet appear that this witness even knows how many communities are to be served by the joint sewer and the question is immaterial and irrelevant.

A. I do not know the precise number there are quite a number.

Q. Is that an important item to know in passing upon the efficiency of the project?

Mr. Riker: The question is objected to on the ground that the

efficiency of the project is not an issue in this case and the question is immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendant.

A. Why, yes it is an important feature especially becoming so at time of storms and thaws.

Q. Do you know what the precipitation is at the Passaic Valley water shed that will be drained by this trunk sewer scheme?

A. Not knowing the area of the shed I could not say.

Q. Is the trunk sewer scheme designed for the dry weather flow, or for the dry weather and storm flow?

Mr. Riker: I enter the same objection as made last.

The Commissioner: Note the objection of counsel for the defendant.

A. It is my understanding that it is designed for maximum flow at any time.

3682 Q. Of both or either, which?

A. Both.

Q. From your study of the Passaic Valley Trunk sewer project would you say that it is designed to take storm water as well as dry weather flow and sewage?

Mr. Riker: The question is objected to on the ground that it is immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendant.

A. I could not state explicitly but I should presume it was designed to take both the sanitary sewage, or the so-called domestic sewage, the trade wastes, up to a volume equivalent to ten per cent of the total volume and such storm flow as would be encountered at time of rain storms. I do not know whether the expedient has been adopted of building into the trunk sewers storm overflows, or into the lateral sewers, but I should suppose that would be the case.

Q. Do you know whether or not it is the case in the present plans of the Passaic Valley Sewerage Commissioners for this trunk sewer?

Mr. Riker: The question is objected to because the witness has not immediately testified before the question was put that he did not know.

The Commissioner: Note the objection of counsel for the defendant.

Dr. O'Sullivan: The question is pressed for the reason that this witness has also testified that he examined the plans in the present month.

A. That is something I do not know, and, further, I would like to state that I was particularly interested in my examination of these plans in the features relating to the treatment of the sewage and to the manner of its discharge in New York Bay.

3683 Q. Is its volume not an important item in considering the treatment it is to be subjected to?

A. It is but I have used the assumptions upon which the design of the sewer was based, namely, in 1940, of thereabouts, the total population to be provided for would be in the neighborhood of 1,600,000 people; aside from the number of people sewerage into the sewers, I have no cause to be interested in what the probably flow of the sewer may be, in as much as I am attempting to draw my inferences and conclusions on the amount of matter which is to be discharged by the population and not on the volume of sewage contributed by them.

Q. What is the volume of sewage to be contributed by the City of Paterson?

A. Throughout our studies of this question in 1907 it was assumed that the domestic sewage flow would be 150 gallons per capita per day. Not knowing the exact population of Paterson at this time I am unable to state what the sewage flow from that city is, but I presume it to be in the neighborhood of 20,000,000 gallons.

Q. How do you estimate the sewage per capita share for Paterson?

A. That is only done in a precise manner by taking the water consumption and gauging the various sewers carrying off the wastes of a particular district.

Q. How do you get the water consumption?

A. By meters.

Q. Is there no water consumed in Paterson that does not come from the public water supply that is metered?

A. I think not. There is, however, a great deal of water used in Paterson around the lower districts, where the mills are located that comes from other sources than the public supply, the bulk of that water being used for power purposes and for the treatment of goods in these mills and it finds its way back into the river and will continue to do so to a large extent.

Q. Carrying the trade wastes with it?

A. Carrying the inoffensive trade wastes with it and at the present time much of the offensive trade wastes.

Q. What percentage of the trade wastes of Paterson is it computed will be carried in this trunk sewer project?

A. I have always supposed that the proper interpretation of that clause of the act referred to the total percentage and not to the individual percentage of any community.

Q. What is the total percentage of trade wastes to be carried in the Passaic Valley trunk sewer project?

A. I understand it to be ten per cent of the total sewage flow.

Q. What is the total trade wastes of the region to be served by the trunk sewer project?

A. In 1907, and eliminating from consideration at this time those districts which are to be withdrawn, the average trade wastes flow amounted, according to my estimates, to about 10,000,000 or 11,000,000 gallons per day.

Q. How do you separate the ten per cent of a given factory from the 90 per cent they are forbidden to convey into the trunk sewer?

A. That is not a simple problem, but it can be affected by co-operation with the superintendent of the mills to a large degree.

If at the present time, with a population of 800,000 people, the trade wastes amount to some 12,000,000 gallons, the completed project with one million six hundred thousand people will give an amount of trade wastes well within the ten per cent limit, because the volume of trade wastes will not increase in proportion to the sewage flow in the future.

Q. Where does the ninety per cent of the trade wastes go that are not gathered in the trunk sewer?

3685 A. I think that is rather an ambiguous question, Doctor, because there is nowhere stated the fact that 10% of the total wastes shall be discharged into the sewer and 90% be discharged into the river or otherwise disposed of.

Q. Then 10% goes into the trunk sewer and 90% of the trade wastes will be discharged into the river?

Mr. Riker: The question is objected to, if it is a question, on the ground that it is a statement of counsel, of a fact not testified to, which, as a matter of fact, is not true.

The Commissioner: Note the objection of counsel for the defendants.

Q. Has any provision been made for the disposal of 90% of the trade wastes of the Passaic Valley Sewerage District that you know of?

A. The matter has never been considered for the reason that in my opinion your assumption is based on conditions which do not and will not exist. The trade wastes phase of the question is, limited to the statement that of the total volume of flow the total volume of trade wastes shall constitute but 10% of the whole volume of sewage.

Q. Have you at no time been aware of what provision was made for the 90% that was left, after abstracting the 10% of trade wastes?

Mr. Riker: The question is objected to on the ground that it assumes as a fact that there will be 90% trade waste left and it does not appear anywhere that such fact exists.

The Commissioner: Note the objection of counsel for the defendants.

A. I do not now consider, nor have I during my investigation of this problem that the percentage of offensive trade wastes will be in excess of 10% of the total volume of trade wastes.

3686 Q. What per cent will they be?

A. I am unable to say.

Q. Of what character will the 90% of the trade wastes be?

A. Undoubtedly some of the 90% will be offensive and be included in the total of 10% of the total volume of sewage which is allowable.

Q. Taking the trade wastes at the original 100% what provision has been made by the Passaic Valley Sewerage Commissioners for separating out 10% of that trade waste?

A. That provision is clearly stated in the Act, that of the total flow of the Passaic Valley District the trade wastes shall not amount to more than 10% of the total volume flow in the sewer.

Q. So that to determine how much trade wastes shall be admitted to the trunk sewer, you have first to determine the amount of domestic sewage that is to be carried and then estimate 10% of that, is that the idea?

A. I should think you would begin at the other end.

Q. I am seeking light. Answer so as to set me right on that?

A. I would arrive at that answer by determining in the first place the volume of trade wastes which would be contributed to the sewer, as was done in the study of 1907; that investigation showed a total of 12,878,000 gallons of offensive trade wastes contributed by about 600,000 people; a similar conclusion could be arrived at when the population reaches 1,600,000 total, or when the project is complete, so as to guard against excess.

Q. How was that estimate made?

A. The estimate I have referred to?

Q. Yes.

A. I have testified at length on this but perhaps I can make 3687 it fairly clear to you.

Each establishment visited was investigated, first as to its water consumption, second as to the amount of chemicals or other matters which were used in the process of manufacture of the goods of that particular establishment. Next, the capacity of such vats or tanks or other receptacles in which dyeing operations, bleaching operations, or similar operations were carried on, was determined, and also the manner in which the contents of those vats, tanks or other receptacles were discharged, whether it was discharged in bulk, or allowed to dribble out during the 24 hours of the day. In this way it was very possible to, arrive at quite actual figures as to the actual volume of the trade wastes of an offensive character which would require to be taken into the sewer and which could not be discharged into the Passaic River without creating color or some other aesthetic nuisance.

Q. Who was to make that determination as to what part of the trade wastes was offensive and what was inoffensive so that it might be admitted into the trunk sewer?

A. I made those decisions in 1907 but eliminated from consideration only such wastes as were so highly diluted as to be only slightly colored, or as contained in them a small amount of other chemicals, acids, alkalis or otherwise.

Q. On your determination would some factories be permitted to pour their wastes, on your judgment of their character into the trunk sewer and other factories be excluded from the trunk sewers?

A. Yes sir, I think that is true.

Q. Do you understand that to be the present mode of selecting this ten per cent of trade wastes for admission to the sewage flow that should be carried and accommodated in the trunk sewer project?

A. No, I cannot say that, I believe that point will be left until the

3688 project is completed, I do not know that it has not been taken up already, but I certainly would be of the opinion and would so advise that the trunk sewer be used until the full project is completed to practically the limit of its capacity, if that capacity can be made up through the addition of inoffensive trade wastes or other diluting waters.

A recess was then taken.

Q. From all the data and observations and study that you have made of the Passaic Trunk Sewer project, do you now state that that is left to be determined as to which or what kind of trade wastes will be admitted to the trunk sewer, as you have stated?

A. That is so, yes, sir.

Q. Has there been any provision of law brought to your attention which would determine that fact other than the way in which you have testified to?

A. No, sir.

Q. I hand you what purports to be the report of the Passaic Valley Sewerage Commissioners to the municipalities lying in whole or in part within the Passaic Valley Sewerage District, dated 1908, and ask you if you have ever read or studied that report?

A. I have, yes, sir.

Q. I ask you if you have read chapter 10 of the laws of 1907 which is in the latter part of that report.

A. I believe I must have read it or glanced over it.

Q. Now I direct your attention to the latter paragraph of section 3 of that law, as appearing on page 2 marked with two Roman figures meaning "2", and ask if you have read this part of the
3689 law:—

In preparing the maps, plans and specifications for the intercepting sewer or sewers, plant or works to be made by the said Commissioners, as herein provided, and in making the estimate of the sewage capacity required for each municipality, regard shall be had by the said Commissioners both to the area and population to be provided for, making provision however, for not more than ten per centum of the factory wastes and excluding all waste from gas works and all substances or discharges which may injuriously affect the integrity of the sewer or sewers then constructed." I now ask you if you have read that section of the law—the laws of the State of New Jersey, being Chapter 10 of the laws of 1907?

A. I have listened to your reading of that section of the law.

Q. Is this the first time your attention has been directed to that section of the law which measures what percentage of trade wastes are to be admitted to the trunk sewer?

A. Specifically, that is so.

Q. Now that your attention has been directed to that section of the law, what percentage or percentum of the trade or factory wastes are to be admitted to this trunk sewer and discharge at Robbins Reef?

Mr. Riker: The question is objected to on the ground that this

witness has not qualified as an expert *on* law, and that the intent of the act, if it is properly proved in the case, must be determined by the Court.

The Commissioner: Note the objection of counsel for the defendants.

A. That is, of course, a legal point which I am unable to interpret, but I see no reason to believe that in intent, any more was meant than that ten per cent of the total volume of sewage to be composed of trade wastes.

3690 A number of years ago, in 1910, to be exact, I referred to this point in an address made before the New Jersey Sanitary Association at their annual meeting, and in this address, I referred to it as follows:

"The restrictions surrounding the construction of this immense sewer require that each community shall be permitted to discharge trade wastes into it, with its domestic sewage, only to the extent of ten per cent of the total volume of the sewage of the community."

As that statement was made in December 1910, and the report of the Passaic Valley Sewerage Commissioners was made in 1908, I believe that my understanding of the proposition, eliminating the amount of trade wastes is now as it was then as above stated.

Q. Do you regard that interpretation which you made in 1910 of the section of the laws of New Jersey, chapter 10 of the laws of 1917, to which I called your attention, as a misinterpretation?

A. It would be hardly proper for me to say that, but I might go as far as to say that I believe it was.

Q. Do you now find in the law I have directed your attention to ample provision for the apportioning the percentage of trade wastes to be carried in the trunk sewer?

Mr. Riker: The question is objected to on the ground that it is immaterial, irrelevant and impertinent to the inquiry, for the reason that the reduction in the amount of trade wastes to be carried and discharged by the sewer will have the result of decreasing the actual amount of pollution of the Bay of New York, if any, due to the discharge from the Passaic Valley Sewer.

The Commissioner: Note the objection of counsel for the defendants.

3691 A. If the restriction holds good to exclude from the sewer ninety per cent of the total volume of trade wastes contributed by the Passaic Valley district, it will be a matter of some difficulty to determine legally what actually constitutes a trade waste. In the case of Paterson the amount of trade waste— which are being discharged into the river at the present time, are, in round numbers 10 or 12 per cent of the total volume of the sewage discharged by that community meaning by that, offensive trade wastes. But Mr. Whipple reports a total volume of trade wastes from the city of Paterson in the neighborhood of 12,000,000 gallons per day; some where between 9 and 10 million gallons of these wastes are considered to be offensive. To exclude all but the ten per cent of the total volume of trade wastes of any character from the trunk

sewer, will be to put an unusual and unnecessary restrictive measures in force, which, in so far as I know, have never been operative in the case of any other sewerage project.

Q. Would it be necessary under the law to which I have called your attention, to depend entirely upon the factories to make the apportionment between the ten per cent which under the law would be received, and the ninety per cent which would have to be taken care of otherwise?

Mr. Riker: The question is objected to on the ground that it is immaterial, irrelevant and impertinent to this inquiry.

The Commissioner: Note the objection of counsel, for the defendants.

A. No, sir, I do not think that it would. There will always be required a certain number of inspectors whose duty it will be to look into such matters as these, and it is perfectly feasible through the medium of such men to so proportion the amount of trade wastes which are discharged into the sewer from any establishment.

3692 Q. Would that entail and inspector for every mill and factory and manufacturing plant using the trunk sewer to discharge the ten per cent of its trade wastes?

Mr. Riker: I make the same objection to this question as last stated.

The Commissioner: Note the objection of counsel for the defendants.

A. No, sir. It is feasible to discharge these trade wastes through pipes or troughs in which might be placed self recording devices that would keep a continuous record on the volume of flow through these pipes or troughs and so check up the actual amount of trade wastes which enter the sewer from any given establishment.

Q. Will that entail the necessity of metering the sewers connecting with the trunk sewers these various mills, factories and manufacturing establishments?

Mr. Riker: I object to the question on the grounds last stated.

The Commissioner: Note the objection of counsel for the defendant.

A. I should not think it would necessarily entail metering it might entail continuous or intermittent measurements.

Q. Do you know where any such devices are now in use?

Mr. Riker: Objected to as last stated.

The Commissioner: Note the objection of counsel for the defendants.

A. For the measuring of trade wastes do you mean, Doctor?

Q. Yes.

A. No, sir. It is never-the-less possible to make such devices have the Passaic Valley Sewerage Commissioners made provisions for such devices?

Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of counsel for the defendants.

3693 A. Not to my knowledge.

Q. What provision has been made for excluding ninety per cent of the trade wastes, as to its disposal?

Mr. Riker: The question is objected to on the ground that there is no justification in the facts that have been shown for the assumption that ninety per cent of the trade wastes is to be excluded. The section of the Statute which has been referred to and upon which this witness is being examined as an expert, provides that in the construction of this work provisions shall be made for not more than a total of ten per centum of trade wastes in the district, and there is no provision in it, nor any actual requirement for excluding any of it.

The Commissioner: Note the objection of counsel for the defendants.

A. I am unable to cast any further light on this point.

Q. How are these trade wastes now discharged, and into where?

A. At present the trade wastes of the Passaic Valley district are either discharged directly into the Passaic River and its tributaries or into the sewage systems and thence into the Passaic River, or its tributaries.

Q. Is there any way of discharging the ninety per cent of these trade wastes that would be refused by the trunk sewer scheme?

A. There would not appear to be.

Q. Do you know if there was any estimate made of the volume of these trade wastes in 1907 or 1908 of the entire volume for the Passaic Valley Drainage area?

A. Yes, sir.

Q. What was the entire volume of those trade wastes?

3694 A. Such an estimate was made in 1907 by me. The total volume of the trade wastes which the district considered in 1907 was figured at 12,889,000 gallons.

Q. As the total trade wastes?

A. As the total trade wastes of the entire district per day. Since half a dozen communities have withdrawn since that time it is necessary to revise these figures, making the estimated total amount of trade wastes contributed daily between 10 and 11 million gallons daily.

Q. What computation was made then as to the volume of trade wastes for the year 1940?

A. From such records as I have in my possession, I find that the total volume of trade wastes estimated for the year 1940, I think, or at the time when the Passaic Valley Sewerage project shall have been completed is given as 62,482,100 gallons per 24 hours. In explanation I desire to call attention to the fact that it was these data and other data contained in the same table which were used as a basis for the design of the trunk sewer, with regard to its maximum carrying capacity. The house sewage is given at a flat

figure of 150 gallons per capita, the ground water leakage is given at the maximum figure of 3,429,300 or, figuring this in another way, the ground water leakage is given as 44,037,800 gallons per day. The total sewerage though at the time the completed project shall be in operation caring for the sewage of 1,649,440 people, is given as 357,365,200 gallons. I want to still further call attention to the fact that although the average sewage flow is 240 million gallons as against 357 million gallons shown in this table, the difference of some fifty per cent is accounted for by the reason that it is necessary to figure maximum sewage flows in order to get at the carrying capacity of the sewer. The trade wastes which in 1907 were estimated at some 12 million gallons per day are given in 1940 at 62 million gallons per day. It is readily seen that these figures are all out of proportion to the domestic sewage flow, which 3695 is in direct proportion; that is made so, in the case of trade wastes, because due consideration was given to the manner in which these wastes were discharged, whether in bulk or dribbled out during the 24 hours of the day. The fact that many dye works, blancheries and other establishments contributing wastes of an objectionable character which would require to be taken into the trunk sewer discharged the contents of their vats and tanks and other receptacles in bulk at one time and within a limited space of time, makes it necessary for the sewer to be able at such times promptly to carry away this abnormally large load, even though it is only temporary. That is responsible for these large figures under the head of trade wastes, which do not represent the average flow of trade wastes throughout three hundred and sixty five days in the year.

Q. What was the maximum capacity for the trade wastes of Paterson computed in that table?

A. This is scattered through (interrupted)——

Q. Let me see if I can give it to you in a compact state. I show you again the report of the Passaic Valley Sewerage Commissioners to the municipalities lying in whole or in part in the Passaic Valley Sewage District, for the year 1908, and direct your attention to page 15 of that report on which appears table "5," and ask if you have seen that table before the time I now show it to you.

A. This appears to be the same table that I referred to, although I have not been able to check the figures as given in this table.

Q. How do the total trade wastes in the table check with the total trade wastes given by you in your testimony just now?

A. They check.

Q. And amount to how much?

A. 62,482,100 gallons.

Q. Do you know who compiled these tables or how they were compiled?

3696 A. I have reason to believe that they were compiled in the office of Hering and Fuller, 170 Broadway, New York City.

Q. Did you participate in collecting the data and in the compilation?

A. I did.

Q. Directing your attention to page 14 of that report, I ask you if you regard the part I am just about to read as fairly representing the facts in regard to the compilation and collection of the data.

I read from the last paragraph on that page of the report now before you:

"The trade wastes were carefully ascertained and the flow is reported in table 5. In this table the rates of maximum flow as estimated, are shown, and the amount of each municipality are tabulated in million gallons per 24 hours. The total amount of over sixty two million gallons shown in the table represents the total daily flow of all trade wastes based on the maximum rate of flow."

Do you recognize that as a fair statement of the care with which these tables were compiled and the matter collected?

A. Yes, sir.

Q. Approximately how much of that trade waste would be contributed by the city of Paterson?

A. From the date given in table number 5, on page 15, to which you have just called my attention, roughly speaking the city of Paterson is shown to contribute trade wastes to the extent of about twelve million gallons, which is about 20 per cent of the total volume shown in this table. Again it becomes necessary for me to call attention to the fact that this does not represent the actual average for trade wastes for 24 hours, but it is the rate of flow on a 24 hour basis. It is the fact that during some time in the 24 hours of the day the maximum flow of trade wastes from the City of 3697 Paterson is equivalent to twelve million gallons per 24 hours.

The actual amount discharged during 24 hours of the same day would be much less; probably much less than one third.

Q. On what do you base that one third computation, Mr. Johnson?

A. From observations which I have had occasion to make in years past, in which I have paid particular attention to this phase of the problem, I know it to be a fact that by far the largest bulk of the trade waste is first stored in vats and when the solutions loose their power for bleaching or for dy-ing the large outlets for these vats are opened and the whole volume of waste discharged at one time into the sewer.

Q. Did you make any direct observation of the trade wastes of the City of Paterson at any time?

A. I have been interested in the silk mills of Paterson for ten years and have been through many of them, and I have had occasion to look into the question of dy-ing processes; not only there but other places, as in Allentown, Pennsylvania, at the works of the National Silk Dying Company; so I have a fairly accurate idea of the amount of wastes which are objectionable and are not objectionable, discharged from dye works of this character.

Q. Earlier in your testimony I understood you to say that you accepted the Whipple and Hazen report in relation to the trade wastes and sewage of Paterson, and that starting on the assumption of their adequacy, you directed your observations to the trade wastes

and sewage of the other towns along the Passaic River. Am I right?

A. As to the details of the trade wastes problem in Paterson, that is true; we looked into the matter in a general way but made no effort to obtain detailed figures in that city.

Q. Are you familiar with the silk industry in particular, as it is practiced in Paterson, as well as in the portion of Pennsylvania that you mention?

A. I have been through all the departments, I believe, but I do not pretend to be an expert silk dyer.

Q. Approximately, how many pounds of silk are manufactured in Paterson every year?

A. I could not tell you.

Q. Do you recall that Messrs. Whipple and Hazen gave it as seven and one half million pounds?

A. I know that they gave the figures as they found them.

Q. Do you know whether or not two thirds of the whole manufactured silk in the United States, is manufactured in Paterson?

A. No, sir.

Q. Do you know how many gallons of water it takes to manufacture a pound of silk?

A. No, sir; those figures are all given in Mr. Whipple's report.

Q. He gives it as one thousand gallons of water being used for every pound of silk or for working days, more than twenty millions gallons a day or two hundred gallons per capita for the entire population. Do you accept those figures?

A. I do, and with the full knowledge that the vast bulk of those dye liquors is in such high state of dilution that they can safely and without offense, be discharged into the Passaic River without nuisance.

Q. Are any of the trade wastes of silk mills offensive that you know of?

A. They are very aesthetically offensive, because, if in their concentrated state, these spent dyes produce color.

Q. And only on color objection you would regard them as offensive?

A. There are certain chemicals used which, if in large amounts would prove offensive, because of their tendency to destroy fish life.

3699 Q. How much in excess of the public water supply is the water used in the manufacture of silk, per capita?

A. I should say in round numbers that it was double.

Q. So that in the case of Paterson and its silk mills the metered water supply would not give you an adequate measure of the sewage per capita of the population, would it?

A. In that case, no. And furthermore, in the case of dye works, particularly silk dy-ing works, we know that the dyers usually have a firm prejudice against the use of a water which has previously been treated with a coagulant, especially if that coagulant happens to be sulphate of alumina therefore we were in full possession of the

facts, namely, that the silk dyers for the most part relied upon other waters than the public supply.

Q. From what sources did they get these other waters, if you know?

A. As to that I am unable to say.

Q. How much soap is used in the silk works of Paterson for every pound of raw silk?

A. I am unable to give you the details on these questions you are asking. If you desire them I can obtain shortly a copy of Mr. Whipple's report in which these statistics are fully set forth.

Q. Would you say that it was more than a pound to each pound of raw silk?

A. I have no knowledge whatever of the amount of soap used in Paterson in the silk dy-ing industry.

Q. Do you know whether or not that soap in large measure passes away with the trade wastes?

A. I would naturally assume that a great deal of it would be likely to provided it was not skimmed off and recovered.

Q. Do you know if they do any thing of that kind or subject the soap in the trade wastes, to any recovering process?

3700 A. I do not.

Q. What extractive matters of silk are carried off in the trade wastes?

A. I regret very much to state that I am not an encyclopedia on the silk industry; I wish I were.

Q. I place at your disposal the report of the joint committee on sewage disposal of the City of Paterson which has been alluded to in your testimony, and which you stated you accepted as representing material matters regarding trade wastes which you made a subject of your investigation, the consulting engineer being Allen Hazen, and the date of the report 1906. If you care to take issue on any statement I made which I draw from that, I will give you the page. Mr. Hazen states that for every pound of raw silk a pound or more of soap is used. Do you accept that statement—you will find it on page 70?

A. I presume that he is repeating Mr. Whipple's statement and I would be merely repeating Mr. Whipple's statement through Mr. Hazen.

Q. In regard to the extractive matter of gum removed from the silk in the process of manufacture, do you regard it as putrescible?

A. I have made no study of the putrescibility of the so called silk gum.

Q. Mr. Whipple states on page 70:—

"This matter is putrescible and contributed in a substantial degree to the pollution of the river." Do you accept that statement after Mr. Whipple had investigated the matter?

Mr. Riker: The question is objected to in that it contains a statement by counsel that certain things are facts, which may or may not be facts as counsel may be properly informed or not properly

informed, but certainly has not been proved in this case, and are not therefore the subject of inquiry.

3701 The Commissioner: Note the objection of counsel for the defendants.

A. On page 12 of Appendix 1 of Mr. Hazen's report I find a statement, by Mr. Whipple bearing on this point, in which he says:—

"For most purposes most of the gum is boiled off, but for souple silks that is, soft and pliable silks, only a part of the gum is removed; and for surah silks very little gum is removed, but the soup-ling baths are soapy and should be discharged in the sewers; subsequent wash waters may be allowed to go into the river."

Q. Directing your attention to page 70 of the report, do you find there a statement that Extractive matter or gum is putrescible, and contributes in a substantial degree to the pollution of the river?

A. I find such a statement on page 69.

Q. Are many chemicals and dyes used in the process of dyeing silks?

A. Quite a number.

Q. Will you name some of them, please?

A. That depends, of course, on the character of the silk which is produced.

Q. In general in the silk industry, name some number of them?

A. I know in a large number of Japanese silks, zinc plays a pretty important part because it has weight, and silk is sold in many cases by the pound.

Q. They weigh all silk do they not, before dyeing them?

A. I believe so.

Q. Do you know whether or not the water in these dye houses is ground water?

A. As a general proposition, if ground water is available which does not contain large amounts of iron, such waters are
3702 generally considered to be very good for dyeing purposes, provided they are not too hard and require abnormal quantities of soap for softening.

Q. Do you know whether or not a considerable portion of the water used in the dye houses in Paterson, is ground water?

A. I don't know that of my own knowledge.

Q. What do you say as to the character of the trade wastes from the dye houses, these dye house liquors are they offensive or inoffensive?

A. I believe, in answering that question, I can do no better than to quote from page 69 of Mr. Hazen's Paterson report above referred to, as follows:

"Of the injurious and polluting substances, by far the greatest quantity is carried by comparatively small volume of concentrated liquor, not exceeding five or at most ten per cent of the total volume of water used in the dye houses. Certain further quantities of discharge contain some polluting materials, but the great bulk of discharge consists of wash water containing only mineral substances

or organic substances in such small quantities that they do not pollute the river."

Of that, how much did he recommend should be removed, of the total volume of the trade wastes?

A. About five per cent of the total volume.

Q. Equal, to what?

A. Or one million gallons per day.

Q. Does he qualify that in any way?

A. He states on page 70,—

"Owing to the difficulty or impossibility of effecting accurately such a separation, the amount actually to be taken care of will perhaps be double this quantity."

Q. Will you turn on page 3 of Mr. Whipple's special report on the composition of Paterson sewage; I will ask you, if it is necessary before designing works for purification, to
3703 know the character of the sewage to be dealt with, if that is an essential for the sanitary engineer?

A. It is, yes, sir.

Q. Do you also have to take into consideration the condition of the sewage with respect to its decomposition?

A. Ordinarily no.

Q. Did Mr. Whipple in his report regard that as an important factor,—the third factor which he considers?

A. He has advanced a truism here on page one, appendix 1, where he states:

"The sewage of a city where the combined system of sewage issued, consists of:

(1.) The public water supply soiled by the waste products of human beings.

(2.) A certain amount of ground water which leaks into the sewers and which is usually more or less polluted.

(3.) Amounts of wash waters from the streets, roofs of houses, and so forth, which varies both in quantity and quality according to the rain fall, and

(4.) The waste waters from manufacturing establishments, soiled in various ways, according to the nature of the industry."

Q. I direct your attention to page three, and in the light of my question will you answer whether or not the third factor considered by Mr. Whipple was as to the condition of the sewage with respect to its decomposition?

A. Yes sir. I find on page three, appendix 1, the statement:

"The condition of the sewage with respect to its decomposition but this can usually be fore-casted if the age of the sewage at the time when it reached the purification works is known."

Q. He states that as his third factor?

A. Yes sir.

3704 Q. What are the most important constituents of the sewage necessary to be known in planning for purification works?

A. There is no general blanket rule which covers the type of purification works which may be adopted and the capacity of them

works properly and efficiently to do the work required of them. In some cases a complete degree of purification is required that is usually almost exclusively, restricted to inland places where the sewage effluent is discharged into running water ways which water ways are used later on as sources of public water supply by the cities lying further down the stream. Complete purification, or as complete as is commensurate with efficiency and cost, is usually adopted in such cases. Other cases where the opportunity for dilution are at a maximum as in the case of large lakes and ponds, may satisfactorily solve the sewage problem by removing from the sewage the suspended solid matters and as a final point of the refinement required, provided the dilution is sufficient to preclude the setting up and maintenance of offensive conditions, is in some cases sterilization of the clarified sewage. In considering an individual problem these questions are always given much thought. On a stream where the nearest water works is one hundred or more miles further away and where the opportunity afforded for adequate dilution are perfect, it is not proper, or at least it is not considered improper by a large number of sanitarians to adopt a process of purification whereby the sewage shall be thoroughly screened and afterwards settled to remove the suspended solids, and in some cases sterilizing the affluent either before or after passing it through some form of subsidiary treatment, such as sprinkling filters, or contact filters which are composed usually of broken stones or slag, and which in effect are not precisely filters but more in the nature of biological machines. We know perfectly well from our own experience, and experiences in England and Germany in particular, about how many people can be cared for per acre of surface of sprinkling or contact filters and we might say, roughly speaking, that in treating the average American sewage the sprinkling filter will probably take care of the sewage discharge of twenty thousand people per acre of filtering surface. These are only general figures but we rely particularly in arriving at the solution of such questions as involve final and complete purification, on the number of people contributing sewage rather than the precise composition of the sewage itself.

Q. Is there any provision in the sewage disposal scheme of the Passaic Valley Sewerage Commission for these stones or biological filters which you have just described.

A. There is not.

Q. How much of the organic matter will be removed by the screens such as described in the stipulation between the Federal Government and the State of New Jersey and marked in this case as complainants' exhibit No. 135?

A. As the result of my observations, and basing my statement upon the results which have actually been affected by screening sewage in various parts of the world, it is possible for me to make the statement that the amount of suspended matter removed by screens will vary from fifteen to fifty per cent of the total suspended matter contained in the sewage.

Q. How fine a mesh would a screen need to have to remove fifty per cent of the suspended organic matter in the sewage?

A. The screens that I have referred to as removing fifty per cent of the suspended matter are of the type used in Dresden where the sewage after passing through the grit chamber is passed through a disc screen which is about five feet in diameter and has openings about one one twelfth of an inch in the clear these openings are rectangular slots.

Q. How fine are the meshes of the screen to be employed by the Passaic Valley Sewerage Commissioners as set forth in the plans for the disposal of the Passaic Valley sewage?

3706 A. It is set forth in the stipulation that the self cleansing mechanical screens shall have clear openings of not over four tenths of an inch.

Q. Is that a fine or a course screen?

A. Four tenths of an inch is a fine screen.

Q. How would you describe the Dresden screens of one twelfth of an inch?

A. That is a very fine screen.

Q. What would you call a course screen?

A. A screen which would be termed a course, and which is usually termed a course screen, is where the bars of the screen are set some two to four inches apart. The purpose of that course screen is to remove heavy floating particles which might get into the pump and cause damage.

Q. And it is not for the purification process proper?

A. They take out some material, but their purpose is as stated.

Q. How much of the organic suspended matter will be removed by a screen with a four-tenths of an inch mesh?

A. The best data on that point are found in "Principles of Sewage Treatment" by Professor Doctor Bunbar, edition of 1908 page 257.

Q. I desire to get your experience, not Dr. Dunbar's.

Mr. Riker: Won't you read that question, please.

(The stenographer read the last question.)

Dr. O'Sullivan: That is from your own experience.

A. I have figured that about twenty per cent, as a maximum, should be anticipated as the efficiency of these fine screens, or screens having openings of four-tenths of an inch.

Q. Twenty per cent of what?

A. Of the total suspended solids.

Q. How about the organic matter as a whole?

A. The amount of organic matter which will be removed by screens of this kind will vary with the composition of the
3707 sewage, of course, you want my own observations, I believe?

Q. Yes.

A. It is a fact nevertheless, that data on this point are very scant, it being a point which has not had particular attention paid to it in the past.

Q. In the operation of your experiments at Columbus how large a mesh did you use in the screens for the treatment of the sewage?

A. The sewage was passed through three screens having clear openings of one-half inch, one-half inch and 3.75 inch, respectively.

Q. Will you express the last in an approximate fraction?

A. It is a little better than one-third of an inch.

Q. And that is a finer than the screen proposed to be used by the Passaic Valley Sewerage Commissioners, is it not?

A. About the same.

Q. One-third of an inch?

A. Oh, a finer screen you say?

Q. It is a finer screen is it not?

A. There are two one-half inch screens and one a little over one-third of an inch.

Q. I say the one-third of an inch screen is a finer screen than that proposed to be used by the Passaic Valley Sewerage Commissioners?

A. It is so slightly less that it is hard to measure; it is 4.00 in the case of the Passaic Valley stipulation as against 3.75.

Q. How would you express four-tenths of an inch in a finer fraction?

A. Two-fifths of an inch.

Q. Which do you regard as the finer screen, that fine screen at Columbus, or this screen that the Passaic Valley Sewerage Commissioners propose to use?

3708 Mr. Riker: The question objected to on the ground that it does not appear what the Passaic Valley Commissioners propose to use except that they will not use one having a larger mesh than a certain designated size.

The Commissioner: Note the objection of counsel for the defendants.

Q. With that limitation will you answer my question, Mr. Johnson?

A. The final screen was somewhat finer than the stipulation calls for as a maximum size in the case of the Passaic Valley project.

Q. You had three sets of screens in Columbus; how many sets of screens are provided for in the sewage disposal scheme proposed by the Passaic Valley Sewerage Commissioners?

A. There are two sets of screens mentioned in the stipulation. At Columbus the extra screen was made use of because of the fact that the sewage used for the tests was taken from an intercepting sewer running some twenty odd feet below the ground. We boxed in the pump suction in this sewer and screened one side of it in order that the sewage entering the pump suction should not contain particles of rags and similar materials which would clog the pump and cause trouble in that way; that was the occasion for the extra screen.

Q. Are pumps to be used by the Passaic Valley Sewerage Commissioners at the sewage disposal works?

A. I believe they are, yes, sir.

Q. Would that provision at Columbus which you put in operation there be a good provision to protect these pumps also?

Mr. Riker: Counsel for the defendants objects to the question on the ground that it is immaterial to this issue.

The Commissioner: Note the objection of counsel for the defendants.

3709 A. For what I have seen of the plans and on reading the stipulation I am inclined to the belief that ample provision has been made to protect the pumps against injury.

Q. Does that rate of flow in any way influence the efficiency of the screen?

A. Within certain limits it is a fact that high velocities tend to force matters through the open spaces in the screen and so reduce its retaining capacity for suspended solid matters.

Q. What was the rate of flow to the screens in the Columbus plant which you operated, approximately?

A. I shall have to figure it for you, sir, we did not pay any attention to that; I can figure it very shortly.

The theoretical lineal velocity or flow to the screen chamber at Columbus was about nine feet per minute.

Q. What is the calculated lineal velocity of flow for the sewage toward the screens, at the Passaic Valley Sewerage disposal works?

A. I do not find that in the stipulation, therefore I am unable to answer it.

Q. Are you prepared to say whether it would be greater or less than the rate of velocity toward the screens of the Columbus plant?

A. No sir, I am unable to answer the question.

Q. What was the detention period in the grit chamber in the Columbus plant?

A. During the period February 18, to June 30, 1905, the retention period in the grit chamber was .29 of an hour.

Q. What page of your report is that on?

A. Page 79.

Q. Turn to page 2151 and see if it is stated differently?

A. No sir, it is here stated as three-tenths of an hour instead of .29 of an hour; one-one-hundredth of an hour different, something less than a minute.

3710 Q. These is a difference, however?

A. I think probably they were just the same.

Q. What is the period of detention calculated for the grit chamber of the Passaic Valley Sewerage Commissioners?

A. I do not find that in the stipulation therefore I am unable to answer.

Q. Do you know whether it is the greater or less period of detention.

A. I do not, no.

Q. How long did it remain in the grit chamber, on an average in the Columbus plant; the detention period, I am trying to get at.

A. That was a variable factor depending almost entirely on the composition of the sewage which varied from time to time, and on climatic conditions.

Q. Did you make a summary of the observations, taking into consideration such variations as would come with climatic or other conditions?

A. I did, yes sir.

Q. I direct your attention to page 151 of that report (Last question here read to witness).

See if you have stated them there.

A. I misunderstood your question, I thought you asked how long did the suspended matter remain in those tanks.

Q. I am speaking of the raw screened sewage which you have described as being sent to the grit chamber.

A. The period of detention in the grit chamber during the Columbus experiments between the dates August 16, 1904, and February 17th, 1905, was one and a half hours; from February 18th, to June 30th, 1905, the detention period was half an hour.

Q. Taking the detention period of one and a half hours, how does that compare with the detention period provided for in the plans of the Passaic Valley Sewerage Commissioners as to 3711 length of time?

A. I do not find that specified in the stipulation and am unable to answer the question.

Q. With a detention period of one and a half hours for raw screened sewage going through these three sets of screens, how much or what percentage of the removal of the suspended matters were you enabled to get. Is it not given on page 151?

A. Yes, sir, but there is one thing that is not stated in the table on page 151, and that is the velocity of flow which has every thing to do with the efficiency of a device of this sort, in the removal of suspended solid matters.

Q. What was the velocity flow with the detention period of one and a half hours by which you found thirty-four per cent removable of the suspended matter?

A. The velocity was 2.61 millimeters per second.

Q. What would that be in feet, roughly or approximately?

A. I suppose it would be close enough to call that about one-tenth of an inch per second.

Q. You considered that work satisfactorily, did you not, and successful?

A. We did not. We found before the experiment ended, as evidenced by the fact that we changed the velocity and period of retention in the grit chamber on February 18th, some four and a half months before the experiments closed, that so much suspended matter was deposited in the grit chamber of an organic nature that septic actions were set up in the deposits causing them to be blown to the surface. During the evolution and ebullition of gas, and that interfered with the process, and subsequent processes, to such an extent that we cut it down in order to get more nearly a true grit chamber such as is used in practically all purification works.

Q. As the result of that experiment did you conclude that the detention period of one and a half hours was too long?

3712 A. For the purpose for which the grit chamber was intended, Yes. We did not want to get septic action in that chamber and we did get it.

Q. And that was the highest per centage that you were able to settle with that detention period, was it not, thirty-four per cent?

A. Yes sir.

Q. What is the detention period provided for in the Passaic Valley Sewerage Commissioners' plant?

A. I do not find that with regard to the grit chamber.

Q. How with regard to the sedimentation plant?

A. I find it is stated in the stipulation that the mean velocity through such tanks shall not be over five-tenths of an inch per second for average flow, and seventy-five one hundredths inch for the maximum flow.

Q. What detention period would that give for the screened sewage in the sedimentation tank or tanks?

A. Under average flow conditions such tank is stipulated to have a detention period of one and a half hours and under maximum conditions of flow a detention period of not less than one hour.

Q. What percentage of the organic matter would you expect to be sedimented under the conditions you have now described as to these detention periods?

A. I have considered that under such conditions there should be deposited at least thirty per cent, or in round figures one third of the suspended matters in the sewage applied to the tank?

Q. Then what would occur to the other two-thirds, it would pass on with the effluent, would it not?

A. No sir, I feel that in the screening device there will be removed suspended matters amounting to, in round numbers, fifteen per cent of the total suspended matters in the crude sewage. I am able to arrive at this conclusion for the reason that careful observations have been made on the operations of a screen of this character located in Hamburg, Germany, such observations having been made by Professor Doctor Dunbar, and referred to in his book "Principles of sewage treatment," page 275, as follows:—

"The amount of the solids removable from sewage by means of gratings, screens, etc., varies very considerably, as is only to be expected from the variations in the forms of apparatus described in chapter seven. If we leave out of consideration screens which are intended primarily to protect the sewage pumps and which have therefore very wide openings, and if we only consider those forms of construction which are intended to reduce the amount of suspended solids, it may be stated that a pound of material is removed for every 22 to 45 persons according to the size of the apertures of the screens, namely, 1.3 to 2.6 cubic yards per day for the sewage of a town having a population of one thousand."

Ratios of a pound of a material removed for every 22 to 45 people are equivalent to 20 to 40 grams per capita per day. With screens of the Hamburg type the lower ratio of 20 grams per capita per day may be taken as to efficiency of the screen, on the basis which I have figured with regard to the probable composition of the Passaic Valley Sewage, namely 75 grams per capita, representing the total suspended matter in that sewage, the removal of this suspended matter by screens of the type used in Hamburg, where the opening between bars is approximately four tenths of an inch would be 26.70 per cent. This is in excess of the figure I have just stated

and is based on actual results with a screen of a type in general accord with the screen described in the stipulation.

Q. In the calculation which is made of grams per capita do you take into consideration the percentage of organic trade wastes to be dealt with?

3714 A. I do, yes sir.

Q. What was the highest per centage of removal that Dr. Dunbar was able to get from the municipal plant at Hamburg?

A. I have not noted that he recorded the variation in per centage, removable in this case.

Q. What was the highest per centage of removal of organic matter that you achieved in the Columbus, Ohio, plant, without chemical precipitation, and with a detention period of one and a half hours?

A. You refer to tank treatment?

Q. Screening and tanks.

A. Screening and tank treatment?

Q. Yes. You will find it on page 151 I think.

A. No, that only gives the result of sedimentation, there is nothing there on screening.

Q. I call your attention to the second paragraph, under the caption of "summary," on page 151 of the Columbus report in which you state that the table following applies to raw screened sewage?

A. That is true, but no allowance is made for the suspended matters removed by screens.

Q. What was the aggregate?

A. That is what I am trying to ascertain, it was not figured.

Q. What percentage of removal of organic matter would you expect, or could be achieved by the scheme proposed by the Passaic Valley Sewerage Commissioners in the sewage disposal plant to be installed at somewhere near the Newark meadows?

A. I have already come to the conclusion that the removal of total suspended matters by the devices called for in the stipulation would be about fifty per cent of the total. So far as answering you-specific question of how much of the total organic matter contained in the sewage in a suspended state would be removed by this

3715 device, I shall have to ask you to let me figure for a moment.

I can, however, state in general terms that in my opinion there will be a removal of total nitrogen equivalent to 40 per cent, of fatty matters of 50 per cent and of total suspended matters of 50 per cent.

Q. How much would that leave of the organic matter in the effluent?

A. That would leave 60 per cent of the nitrogenous matters and 50 per cent of the total suspended matters.

Q. In the effluent?

A. In the effluent.

Q. And the effluent you would describe, would you not, as what was left after this treatment?

A. Yes sir.

Q. Could these works be operated on the Newark meadows without giving rise to nuisances or offense of any kind?

Mr. Riker: The question is objected to as an immaterial inquiry in this case and in no way concerning the complainant.

The Commissioner: Note the objection of counsel for the defendants.

A. I believe that they could, basing my judgment on personal observation of sewage works in this country and abroad, in England especially where such works as these are immediately along side of public high ways and close enough to toss a stone into and in some cases in residential sections of some class.

At this point the further taking of testimony on behalf of the defendants was adjourned to Wednesday the 19th day of February, 1913, at 10:30 o'clock A. M. at the office of Messrs. Riker and Riker, Newark, New Jersey.

3716 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
vs.

THE STATE OF NEW JERSEY AND PASSAIC VALLEY SEWERAGE
COMMISSIONERS, Defendants.

Taking of Testimony at the Office of Messrs. Riker and Riker,
Newark, N. J., Wednesday, February 19th, 1913.

Before James D. Maher, Esq., Commissioner.

Appearances:

Thomas Carmody, Esq., Attorney General of the State of New York; William A. McQuaid, Esq., Deputy Attorney General; Dr. William J. O'Sullivan, Special Counsel, for the People of the State of New York, Complainants; Edmund Wilson, Esq., Attorney General of the State of New Jersey; Robert H. McCarter, Esq., of Counsel for the State of New Jersey; Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

3717 Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

GEORGE A. JOHNSON assumes the stand.

Further cross-examination by Dr. O'Sullivan:

Q. What is the area of the drainage basin of the Passaic River?

A. I have already testified to the fact that I am unable to state this area but referring to what I believe to be a copy of the 1908 report of the Passaic Valley Sewerage Commissioners, I find the statement that; "The present sewerage district was created by an act of the Legislature of 1902 and covers an area of about 77 square miles, upon which in 1905 lived a population of 572,200 persons."

The area outside of the present district for which it seems desirable to make provision in the proposed sewer capacity was fixed as follows after careful consideration. To the North and east of Paterson and between it and Garfield there is an area contributory directly to the Passaic Valley of 10.8 square miles."

Q. Will you refer me to the part of the report where that appears.

A. The only statement I find of a specific nature bearing on this point is contained in the published report of the Passaic Valley Sewerage Commissioners, of 1908, page 7 as follows: "The present sewerage district was created by an act of the Legislature of 1902 and covers a area of about 77 square miles upon which in 1905 lived a population of 572,200 persons. The area outside of the present district, for which it seems desirable to make provision in the proposed sewer capacity was fixed as follows after careful consideration. To the north and east of Paterson and between it and Garfield there is an area contributory directly to the Passaic Valley of 10.8 square miles. This area includes a portion of Prospect Park not included in the drainage area of Olderbrook, Gafflebrook and portions of Hawthorne, Ridgewood, Greenrock, and Saddle River Township."

Q. Where would this territory drain directly into, that you have just read?

A. "Naturally this territory would drain directly into the Passaic River through a series of short sewers."

Q. You have now read from page 7 of the report of the Passaic Valley Sewerage Commissioners to the municipalities lying in whole or in part within the Passaic Valley Sewerage District dated 1908, have you not?

A. I have, yes sir.

Q. My question, Mr. Johnson, calls for your estimate of the drainage basin of the Passaic River, the area of that drainage basin.

A. The drainage area of the Passaic River in so far as the Passaic Valley sewage project is concerned, I take to be from the above statistics about 87.8 square miles. I have no knowledge of the total drainage area of the Passaic River at hand.

Q. Have you read or studied the report of the joint committee on sewage disposal of the city of Paterson furnished to the City of Paterson in 1906, and which you described previously as the Hazen and Whipple report?

A. I read such a report shortly after its publication and have referred to it many times since then.

Q. On page 5 of that report it is stated:—

"Its drainage basin (meaning the Passaic River) covers 949.1 square miles."

Have you any reason to doubt the accuracy of that estimate?

Mr. Riker: The question is objected to on the ground that it is based upon the statement of fact with regard to this report which has not been proved.

3719 The Commissioner: Note the objection of counsel for the defendant.

A. I assume that the statement you have made is correct, although I have no precise knowledge.

Q. I show you what purports to be a printed copy of the report itself, of the joint committee on sewage disposal of the city of Paterson, and call your attention to page 5 of that report, and under the heading of "Passaic River", ask you if it is not set forth that its drainage basin covers 949.1 square miles?

Mr. Riker: The question is objected on the ground that if the report, or any part of it is to be used in this way, it should be proved and admitted as an exhibit.

The Commissioner: Note the objection of counsel for the defendants.

Dr. O'Sullivan: The question is pressed for the reason that there is a provision in the law creating the Passaic Valley Sewerage Commissioners to take over all the reports, plans, specifications and investigations of the city of Paterson on the payment of a stipulated sum of money, and on the city of Paterson officially signing the contract to enter into the Passaic Valley Trunk Sewer project.

A. I find such a statement made in the report mentioned.

Q. In computing the total volume of the trade wastes for year 1907, what was your estimate of their entire volume for the Passaic Valley?

A. 12,889,000 gallons per day.

Q. That is the total volume you have now given me?

A. That is the total volume figured in 1907.

Q. What investigation was made relative to the quality of those trade wastes other than what you have already stated in your testimony?

A. Careful investigation of the trade wastes of the various communities was made and the result reported in considerable detail. Those details have not as yet been read into the record, but if you desire them I will do so. Do you desire them?

Q. Yes.

A. I will read the following from my typewritten notes bearing on the subject. These notes were prepared from data obtained by the various field men and were compared by me so that I am able to testify to their substantial correctness.

Q. In what did the comparison consist, Mr. Johnson?

A. The records were obtained by the field men and recorded in the field books; they were brought to my office and there I made a transcript of those notes and the typewritten copy I have before me represents my digest of these details.

Q. You said you compared them with something; I wish to know with what you compared them.

A. With the original field notes in order that no mistakes might creep into the typewritten copy.

Q. Then as I now understand it the digest which you are now

about to read you compared with the original field notes from which the digest is made?

A. That is so, yes sir.

Q. That is the only check or comparison that you made with any other standard?

A. As a whole that is true. But it is also true that I made several trips to the Passaic Valley District for the purpose of personally investigating the trade wastes problem in order to check up the results which were obtained by the field men. These trips on my part did not cover, however, the entire investigation.

Q. What did you do on these trips, Mr. Johnson, in the way of making any direct examinations yourself?

A. During the investigations, and particularly in the beginning, I accompanied the field men and instructed them as to the data desired and how to obtain them.

Q. Were any chemical determinations made during the progress of the field work?

A. Not as regards the composition of the various trade wastes in themselves.

Q. Were any chemical determinations of any kind made during these operations by either yourself or the men who were doing the field work?

A. Only with respect to the amount of dissolved oxygen in the various sewers discharging into the Passaic River.

Q. Were any other determinations made of that sewage than the oxygen determinations?

A. No sir.

Q. What method was used in making the oxygen determinations?

A. The method described in the report of the committee on standard methods for water and sewage analyses, published in 1905?

Q. Do you know the method which is known to engineers as the Winkler method?

A. Yes sir.

Q. Was that method used?

A. There are parts of all methods for the determination of dissolved oxygen which are incorporated in the standard method above referred to.

Q. I ask you if the Winkler method was employed on that occasion when you examined the sewage in those trunk sewers?

A. It was.

Q. What other methods of oxygen determination do you know of beside the Winkler method?

A. There are methods which prior to the publication of the report on standard methods, among the more prominent being the method of Thresh and the method of Levy.

3722 Q. Have you ever heard of the Letts-Adney method?

A. I believe that to be a method which has been developed since I was a member of the committee on standard methods.

Q. How does the Winkler method differ from what you have described as a standard method?

A. In hardly any essential particular.

Q. Will you describe the standard method, Mr. Johnson?

A. In as much as I aided in the preparation of this report and in order to make the record clear, I believe I can do no better than to read the standard method used by us in the determination of dissolved oxygen in the discharge of the sewers entering into the Passaic River in 1907.

Q. Who prescribed it as a standard method?

A. The committee on water and sewage analyses.

Q. Did the American Health Association ever endorse that method?

A. Yes sir.

Q. And it appears in any of their reports does it?

A. I do.

Q. Will you describe the method employed? Before doing that will you please tell me what report you read from?

A. The report of the committee on standard methods of water analysis made up to the laboratory association of the American Public Health Association, and presented at the Havana meeting January 9, 1905.

"Determination of dissolved oxygen", Page 74 of above report.

Q. There are three methods in use for the determination of atmospheric oxygen dissolved in water, namely those of Winkler, Thresh and Levy. Each of these methods has its own particular field of usefulness, all are capable of giving sufficiently accurate results.

"The Winkler method is in the most common use in this country and possesses the advantages of requiring only simple and not readily breakable apparatus. It is therefore recommended as the standard method.

"The method of Thresh — perhaps slightly more accurate than the Winkler method, but the apparatus is not so well adapted for field work. For certain purposes, however, as for example the determination of dissolved oxygen before and after incubation, it is more practical than the Winkler method because the apparatus allows of the taking of representative samples direct from the bottles or other containers.

"What is true of the Thresh method is also true, to a great degree of the Levy Method. With both of these methods the samples are taken in a special stopper separatory funnel."

Reagents.

The reagents used in making the determination are manganous sulphate solution of sodium, hydrate of potassium, iodine solution sulphuric acid and sodium thiosulphate solution; starch solution is used as an indicator.

"In collecting the samples it is always necessary to guard against the entrainment of any oxygen from the atmosphere. The sample bottle is usually glass-stoppered, has a narrow neck and holds about two hundred and fifty centimeters. If the sample is to be collected from a tap the water is made to enter the bottle through a rubber tube which reaches to the bottom of the bottle, the water being

allowed to overflow for several minutes, after which the glass stopper is carefully replaced so that no air bubble is caught beneath it.

"When the samples are collected from the surface of a pond or tank two bottles are used, one being the ordinary sample bottle and another a bottle of about four times the size of the sample bottle. Both bottles are provided with temporary stoppers of double perforations, and in both cases a glass tube extends through one hole

3724 of the stopper to the bottom of the bottle and a short glass tube enters the other hole of the stopper but does not project into it. The short tube of the sample bottle is connected with the long tube of the same. In collecting the samples, the sample bottle is immersed in the water and suction applied to the short tube of the large bottle and enough water drawn through the hole to fill the large bottle. In this way the water in the smaller bottle will be changed several times and a fair sample obtained."

Q. Was that done in these determinations that you made of the sewage of these trunk sewers or out-falls?

A. Wherever it was possible this method was used. In some cases it was not feasible to enter the sewer, and in those cases a large bucket of the sewage was drawn up from the sewer and the sample bottle filled from it as above described.

Q. Was any other safeguard adopted prior to taking the oxygen reading itself either before using the reagents or during their use?

A. The only safeguards taken were to avoid the entrance of air into the bottle at any time, and the determination was made promptly after collection of the samples its temperature being recorded at that time, in as much as the temperature has considerable effect on the quantity of dissolved oxygen which the water can contain.

Q. Then the only determinations made were those for oxygen, is that right?

A. Yes, sir, that is so, with the exception of a few determinations made at the time the dispersion tests with the red dye were made in the harbor; at that time a few determinations were made of the amount of chlorine in the water at the point where the pontoon was anchored and at different depths.

Q. Was that made chemically or with the use of a salinometer.

3725 A. That was made chemically.

Q. What did you find the salinity to be at that point in the upper bay where you made your determinations?

A. My memory is fairly clear on that point and I remember distinctly that the chlorine contents of the water on the day of the analyses ranged from some nine thousand to some twelve thousand parts per million.

Q. Do you call that a high or low salinity?

A. In round numbers it is about half the salinity of sea water.

Q. So that you would describe it as brackish water.

A. I presume you would describe it as brackish water, yes, sir.

Q. About these determinations in the Passaic River itself; did

you make any determinations in 1907 that you have been describing other than the oxygen determinations of the sewage?

A. I do not recall that we did.

Q. Did you make any oxygen determinations at any point in the river itself?

A. We did not for the reason that it was clearly evident that the Passaic River contained no oxygen at that time.

Q. How was that evident to you?

A. From the fact that the surface of the river practically at all times on which I have had an opportunity to view it, and particularly in its lower reaches, is covered over the most of its surface with bursting air bubbles which can only come from the results of putrefactive agencies actively going on in the deposits on the bed of the stream. These agencies speedily result in the complete absorption of whatever atmospheric oxygen the water may contain.

Q. Do you describe them properly as air bubbles, Mr. Johnson?

A. In the sense that air is a gas, yes sir.

3726 Q. Then there was air in those bubbles?

A. I presume that is a fine distinction; probably those bubbles contain marsh gas, and other gaseous results of bacterial putrefaction and decomposition.

Q. Was any effort made to determine as to what gaseous product of this decomposition consisted?

A. No sir, I have made determinations of that sort but not in the Passaic River.

Q. Was there any other effort made during your investigation to determine the quality of this sewage other than the oxygen determinations that you described, during 1907?

A. I believe we roughly recorded the odor of the samples as drawn from the sewer.

Q. Do you remember what that odor was described by you as?

A. Yes sir. Of the discharge of the thirteen outlets referred to previously in my testimony the odors were recorded in the case of each, respectively, as follows: "very faint" "cesspool" "faint" "Cesspool" "Musty" "Cesspool" "painty" "faint" "cesspool" "Cesspool" "cesspool" "cesspool" "cesspool".

Q. What did that term "cesspool" distinguish the sewage as in making that odor, what appearance?

A. The characteristic odor of decomposition of sewage.

Q. When you employ the term "faint" what did that import as to odor and the appearance?

Mr. Riker: If it did import any thing as to appearance.

A. The term "faint" refers to any very slight odor which was apparent.

Q. Was it by the appearance and the odors such as you have just detailed that you separate these sewages into offensive and inoffensive?

A. As a matter of fact we never separated the discharge of these sewers into classes; we merely determine the dissolved oxygen contents in each and record the odors as recorded above.

3727 Q. Upon what did the classification "offensive" and "in-offensive" depend?

A. We made no such classifications.

Q. Neither for sewers or trade wastes?

A. In the case of sewage, no; in the trade wastes "Offensive" was the term used to designate wastes of a character which would be likely to set up offensive conditions in the river if discharged into it in sufficient volumes.

Q. The classification then did not depend upon any odors or any appearance that the sewage conveyed to those who examined it?

Mr. Riker: I object to the question in that it is not definite, the subject having been trade wastes to which the word "offensive" has been applied and not to the word sewage.

The Commissioner: Note the objection of counsel for the defendants.

A. No sir, for the reason that these wastes as discharged were fresh and had not in a majority of cases undergone such changes as would make them offensive to the senses.

Q. Were any of these sewers discharging directly from factories?

A. I have been testifying as to trade wastes; I should like to make that clear. But in one of the samples collected, in as much as the odor is described as "pointy" I judge that this was directly connected with the sewer. There are undoubted numerous instances where this is true in the case of the sewers discharging into the Passaic River.

Q. My question was directed to elicit the fact, Mr. Johnson as to whether or not any of the sewers examined in 1907 either by yourself or the field force discharge directly from factories or manufacturing plants of any kind?

A. We made no note of this point in connection with our study of the discharge of those thirteen sewers.

3728 Q. In 1907 what was the estimate of the total volume per day in gallons of the trade wastes expected to be discharged in 1940?

A. In 1907 it is estimated that the total amount of trade wastes which would be required to be taken into the trunk sewer was 12,889,000 gallons per day; I am of the impression that no estimate was made of the probably quantity of trade wastes to be expected from the entire district in 1940. The trade wastes, in all probability, would not increase in volume in proportion to the sanitary sewage flow.

Q. Were there any estimates at all made of the entire volume per day in gallons of what was anticipated to be the total volume of the trade wastes for 1940, during these estimates that were made in 1907?

A. Yes, such estimates were made in order that the maximum carrying capacity of the sewer might be determined. The probable amount of trade wastes, in average daily volume, in 1940, was not estimated. In estimating the maximum flow of trade wastes at any particular minute in the 1440 minutes of any particular day it was

figured that trade wastes would be flowing in the sewer at the rate of 62,482,100 gallons per 24 hours. This is meant to represent the maximum rate of flow in the sewer at any time and not the actual daily volume of trade wastes to be expected in 1940.

Q. How would it compare with the daily volume of the trade wastes to be taken into the intercepting sewer?

A. The maximum rate of discharge of trade wastes through short periods of time would probably be in the neighborhood of three times the average daily flow.

Q. What was the estimate for the entire volume of trade wastes of the region to be served by the trunk sewer project, apart from the ten per cent that was to be carried in the trunk sewer?

3729 A. We always and consistently figured an average flow of 150 gallons per capita per day; with the completed project in which a population of 1,600,000 persons were to be provided for, we figured an average sewage flow of 240 million gallons per day. In designing the main trunk sewer we took in consideration peak loads as regards sewage flow estimating them at approximately 50% in excess of the average flow for the day, or in round numbers we figured that during any particular short period in any particular day the maximum rate of discharge of the trunk sewer in 1940 would be 360 million gallons.

Q. That would include the entire amount of sewage and ten per cent of the trade wastes would it not?

A. We come back here to a point of law upon which I am unable to give you a satisfactory answer, that is to say, as to the percentage of the total sewage flow which is to be made up of trade wastes alone.

Q. Are you still in doubt Mr. Johnson as to the mode of measuring the percentage of trade wastes to be taken into the Passaic Valley Trunk Sewer?

A. I am in doubt and am of the opinion that the wording of the law is somewhat ambiguous. I certainly believe that if the precise phraseology means that of all of the trade wastes of the Passaic Valley District only ten per cent of the same shall be allowed to enter the sewer that this is a restriction not only uncalled for, but in all probability not so meant. My interpretation of this clause as already set forth is that when the project shall have been completed, of the total volume of discharge from the Passaic Valley Trunk Sewer but ten percent of that volume shall be trade wastes, and no more.

Q. According to your interpretation of the laws of the State of New Jersey for 1907, chapter 10, which is an Act to provide for purification of the waters of the Passaic River, you would have to know what the entire volume of sewage discharge was before you could estimate the amount of trade wastes that could be accommodated. Is that right?

3730 A. I suppose in a general way that may be considered to be correct.

Q. I will again direct your attention to the section of the law which is mandatory, relative to the percentage of trade wastes and

will ask you to follow me if you will with the copy of the report of the Passaic Valley Sewerage Commissioners for the year 1908 in which this law is set forth, under the Roman numeral "II", the second last paragraph on the page and the last paragraph in section 3.

"In preparing the maps, plans and specifications for the intercepting sewer or sewers, plant or works to be made by the said Commissioners as hereinafter provided and in making the estimate of sewage capacity required for each municipality *rerags* shall be had by the said Commissioners both to the area and population to be provided for, making provision however, for not more than ten percentum of factory wastes and excluding all wastes from gas-works and all substances and discharges which may injuriously affect the integrity of the sewer or sewers when constructed."

I now ask you Mr. Johnson if that section of the law of 1907, chapter 10 section 3, does not distinctly provide for the measurement of the percentage of factory wastes as 10% of the entire factory wastes, which is it be accommodated in that sewer, and that it is not in direct relationship with the sewage itself, as the standard of measurement for the amount of trade wastes to be accommodated in the trunk sewer?

Mr. Riker: Objected to on the ground that the section of the act speaks for itself and is to be interpreted by the court and not by this witness, and that in any event if the view suggested by counsel for the complainant is correct it will result in a less discharge of polluting trade wastes into the bay of New York than this witness

has been estimating in his testimony and goes simply to the question of the efficiency of the plan as the Passaic Valley sewer district is concerned and does not in any way concern the complainant in this case.

The Commissioner: Note the objection of counsel for the defendants.

Dr. O'Sullivan: The question is pressed by counsel for the complainant on the ground that the measure of the trade wastes will materially affect the question of disposal and sewage treatment as to the efficiency and as to the character of the effluent to be discharged into New York Upper Bay.

A. I do not feel that I am competent to pass upon what is obviously a point of law. The statement, as I have said, is clear that in that provision is made for not more than 10% of the factory wastes, but it is conceivable that there might be some discussion over what is really meant by "factory wastes." The law is explicit in excluding gas wastes, therefore it is not without reason to suppose that "factory wastes" might mean one thing and "trade" wastes another thing.

Q. Do you make such a distinction Mr. Johnson?

A. I always have, yes, sir.

Q. How would you distinguish a factory waste from a trade waste?

A. I can conceive starch works, galvanizing works or tanneries

as not being factories; nevertheless they discharge of offensive trade wastes.

Q. How would you class those wastes you have just enumerated as factory or trade wastes?

A. I would classify them as trade wastes.

Q. In what description would be considered the factory wastes?

A. An example might be mentioned in the case of a hat factory, which also discharges offensive trade wastes.

Q. How many manufacturing plants along the Passaic River discharge factory wastes and how many trade wastes?

3732 A. I could not tell you because it is hard for me to separate in terms that would be understood and taken as standard. mills, and factories and other manufacturing establishments. I find, for instance, in Passaic, three woolen mills, one print works, one chemical works, one rubber factory, one brewery but I certainly should not call a brewery wastes factory wastes. The rubber factory is clearly designated.

Q. Are there along the Passaic River and discharging into the Passaic River *abbatoirs*, bleacheries, breweries, chemical works, coal washings, cotton mills, creameries, dairies, distilleries, *gye-works*, gas works, laundries, leather dressing works, paint mills, paper mills, paste-board mills, pulp mills, silk mills, slaughter houses, starch works, straw board mills, sugar factories, sulphate mills, tanneries, and woolen mills, as well as yeast factories?

A. Yes, I believe that all of the industries you have mentioned are represented on the line of the trunk sewer.

Q. Which of these, Mr. Johnson, would you classify as factories and as yielding or contributing factory wastes and which would you classify as yielding or contributing trade wastes?

A. It seems peculiar, if this is the point, and I think it undoubtedly, is, that of all these various industries are not designated as factories, as in the case of sugar factories the class that discharge trade wastes and which certainly cannot be considered as factory wastes, I would name the *abbatoirs*, breweries, chemical works, coal washings, creameries, dairies, distilleries, gas works, laundries, starch works, tanneries and even yeast factories. The only eliminations that have been made which might or might not come under the factory class are the bleacheries, cotton mills, dye works, gas works, leather dressing works, paint mills, paste board mills, pulp mills, silk mills, straw mills, straw board mills, sugar factories, sulphate mills and woolen mills.

3733 Q. In the distinction between factory wastes and trade wastes a recognized distinction among sanitary engineers, Mr. Johnson?

A. I cannot at this moment recall any text book on the treatment of factory wastes; I can however recall standard works on the treatment of trade wastes.

Q. Does any work written by any engineer in any language in any country draw a distinction between factory wastes and trade wastes that you know of?

A. They may not and probably do not attempt to distinguish between them.

Q. Are you now making a distinction for the first time between factory wastes and trade wastes?

A. I am saying that in the case of a legal argument that point unquestionably would be considered very carefully in my opinion.

Q. I am asking you, Mr. Johnson, as a sanitary engineer, not as a gentleman versed in the law.

Mr. Riker: What are you asking him?

Dr. O'Sullivan: I ask you Mr. Johnson, whether you are making the distinction now for the first time between factory wastes and trade wastes?

A. No, sir, I do not think I am. I recognize that factory wastes may be trade wastes, but I do not recognize that all trade wastes are factory wastes.

Q. How do you distinguish them?

A. I have already set forth my views in as much detail as I am able to.

Q. Then as you interpret the laws of the State of New Jersey, chapter 10 of the laws of 1907, relating to the Passaic Valley sewerage project, you interpret that only provision is made for factory wastes, am I right?

Mr. Riker: The question objected to is objected to on the ground that that is what the law says, it is not the interpretation by this witness of it at all.

3734 The Commissioner: Note the objection of counsel for the defendants.

A. That is the only one that is specifically mentioned with the exception of the waste from the gas works, which are explicitly excluded.

Q. Would the factory wastes or the trade wastes affect the integrity of the sewer as set forth and provided for in the Laws of 1907 of the State of New Jersey, chapter 10?

A. It is conceivable that certain trade wastes in sufficient volume might affect the integrity of the sewer.

Q. Which trade wastes or factory wastes would be likely to affect the integrity of the sewer?

Mr. Riker: The question is objected to on the ground that the witness has testified that factory wastes are less inclusive than trade wastes and that his attention should be directed to which particular designation the question is intended to apply.

The Commissioner: Note the objection of counsel for the defendants.

A. Such wastes as strong free acids, but the likelihood of their being acids in free form present in the sewage going into the trunk sewer is not good.

Q. My inquiry, Mr. Johnson, related to trade wastes and factory wastes, and I now ask if it is unlikely that the spent liquors would

contain acid wastes from either factories or from manufacturing plants that would contribute trade wastes to the trunk sewer?

A. Some of the industries undoubtedly discharge acid wastes but they are spent acids as a rule and not in their active state.

Q. Then from what character of factory or trade wastes would you expect the integrity of the sewer to be assailed?

A. From such observation as I have made I am of the opinion that none of the wastes which will enter the Passaic Valley trunk sewer will be present in sufficiently large volumes to affect the integrity of the trunk sewer.

3735 Q. Although the law provides for maintaining the integrity of the sewer against these trade or factory wastes?

Mr. Riker: The question is objected to on the ground that it contains a statement of a conclusion of law by counsel which is not in accordance with the statute and not warranted by any interpretation of the statute.

The Commissioner: Note the objection of counsel for the defendants.

(The question was read to the witness.)

Mr. Riker: You had better read the statute before you attempt to reply to that question.

A. I find a clause in chapter 10 of the laws of 1907 which states: *— "Exclude all wastes from gas works and all substances or discharges which may injuriously affect the integrity of the sewer or sewers when constructed."

The word "integrity" I believe to be capable of several interpretations; it may mean disintegration, it may mean diminution in capacity; it is without doubt not only possible but probable that due provision will be made by the authorities of the Passaic Valley District for the proper treatment of all trade wastes which enter the sewer in order to guard against both of those points and to comply with the law.

Q. What trade or factory wastes would you expect to assail the integrity of the trunk sewer even on your own description Mr. Johnson?

A. Of the wastes that are now being discharged in the Passaic Valley District the acids wastes are the only ones that I should look on with any apprehension and I do not believe that acids are present in sufficient quantities to affect the integrity of the sewer so far as its disintegration is concerned.

With regard to the feature of clogging whereby the carrying capacity of the sewer would be diminished, sewages carrying large quantities of grease and solid matters in suspension might
3736 allow them to gather on the sides of the sewer and so ultimately affect the carrying capacity.

It is true that these things may be minimized before the sewage enters the trunk sewer, it is also true that in sewers of this size particularly it is no difficult matter to prevent the accumulation of deposits on the inner side of the sewer by systematic screening. So I see

no reason to be apprehensive that the integrity of the sewer would be affected by the discharge into it of trade wastes.

Q. Are there steel works in Paterson?

A. Yes sir.

Q. What are the pickling liquors that they discharge as trade wastes, in character?

A. They are composed very largely of hydrate of iron.

Q. Do they affect structures such as the trunk sewer unfavorably and to their disintegration?

A. When present in sufficiently large quantities they doubtless would.

Q. Do you recall an experience with acid wastes in the Bergen Hill which menaced the cement tubes put in by the railroad, and as to their disintegration by these acid wastes?

A. I do not. But I infer that the liquids flowing in the sewer was composed very largely of these wastes that you mention.

Q. And that they disintegrated the cement tubes?

A. It is possible that they would.

Q. What liquors will disintegrate concrete?

A. Strong acids.

Q. How will sugar solution affect them?

A. Through the fermentation of the sugar I can conceive of an action which would cause disintegration.

Q. How will glycerin trade wastes affect them?

3737 A. Through the same agencies as I gave of sugar solutions.
Q. How will gas and ammonia waters, as trade wastes, affect them?

A. The discharge from gas works is expressly prohibited in this case, as it usually is in all sewers, the wastes have a tendency to not only cause disintegration but also affect the carrying capacity of the sewer through the deposit on the inner side of the sewer of a tenacious film of tar.

Q. Are gas and ammonia trade wastes contributed by other factories and manufacturing plants than by gas works?

A. Ammonia liquors may be, but gas liquors I believe not, in any considerable quantity. Asphaltum works will probably contain some, rubber works might.

Q. How are the trade wastes from the gas houses in Passaic now discharged?

A. I don't know.

Q. Are you sure, Mr. Johnson, that they are not now discharged into the sewers?

A. It is possible that they might be, and if so it is not altogether strange, even though it is the worst practice that can be imagined; it is true of other cities as well as Passaic, I have noticed it in other places?

Q. How do ammonia waters disintegrate the cement or concrete including in ammonia waters ammonium sulphate, ammonium carbonate, as well as ammonia liquors?

A. I cannot tell you, but I can express the belief that such waters

will never be allowed to run waste in large quantities because of their value.

Q. Taking the product of decomposition itself, do you know of any of the products of decomposition that would affect unfavorably, even to the extent of disintegration, the concrete lining of sewers?

A. I could express the belief that the most active disintegrating agents produced by the decomposition and putrefaction of
3738 sewage matters would be carbonic gas.

Q. Would not hydrogen sulphide disintegrate concrete much more rapidly and effectually than any of the agencies that we have now described in the questions and answers which have preceded this question?

A. If present as such it probably would; but it is also true in the case of virtually all sewages, in some more than others, that there is sufficient iron contained in the sewage to form a combination with the sulphurated hydrogen produced and the resultant precipitant is composed of iron sulphide which is in itself inert.

Q. Is the affinity of hydrogen sulphide, or as you have described it, sulphurated hydrogen, greater for the iron contents or for the constituents of concrete or cement?

A. I believe that they are more active in the case of the iron; I know that they are especially active in this regard.

Q. Do you know of any experiments along this line that have been reported by William M. Barr issued as a bulletin of the Iowa State College of Agriculture and Mechanical Arts, and by R. E. Buchanan of the Iowa State College, and reported in the engineering News of December 14th, 1912?

Mr. Riker: The question is objected to on the ground that it is immaterial and irrelevant, and this whole line of examination is objected to on the ground that it goes to the efficiency or propriety of the plan of the Passaic Valley Sewerage Commissioners, and has nothing whatever to do in any possible view with the question at issue in this case and is simply an attempt on the part of counsel to inject into the case criticisms of the judgment and plans of the Commissioners, without any reference to the issues.

The Commissioner: Note the objection of counsel for the defendants.

3739 A. I have read these articles, but my recollection of them is not clear at this time.

Q. Mr. Johnson, how do coconut oil and sugar affect concrete?

Mr. Riker: I desire to object to the question on the same grounds as last stated.

The Commissioner: Note the objection of counsel for the defendants.

A. I presume it affects in through the production of such compounds as result from the fermentation of those two articles.

Q. Is there any direct chemical union between the substances I have just named and any of the contents of the concrete itself?

A. I do not know.

Q. Let me draw your attention to the experiments of Mr. Furber, as published in the Engineering News for January 16, 1913, relative to the effects of cocoanut oil and sugar on concrete, and ask you if they have in any way conformed with your experience?

"I have found that the destruction action of the oil in converting the lime of the portland cement into lime soap is very rapid. By subjecting a sample of hardened concrete to the action of the oil for two weeks, the deterioration is very noticeable."

Have you had any such experience among your experiences?

Mr. Riker: The question is objected to on the same grounds as last stated.

The Commissioner: Note the objection of counsel for the defendants.

A. I have not, and the experiment is interesting only as showing the specific effect of a specific compound concentrated on concrete. It does not represent conditions in any way near approaching those to be encountered in actual practice.

Q. Are cocoanut oil and sugar refuse among the trade contributions of the Passaic Valley manufacturing plants or factories?

A. I do not recall the cocoanut oil but the sugar mill I recollect distinctly.

Q. What in general is the effect of mineral and vegetable oils in trade wastes or factory wastes on concrete with which they come in contact in sewers?

Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. I would not attempt to say, but I have seen many concrete floors thoroughly saturated with mineral oils which showed no visible signs of disintegration.

Q. Do they act differently in sewers where decomposition changes are taking place in their immediate vicinity?

Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. I presume they might, but their volume would be necessarily small as compared with the total flow of the sewage.

Q. What provision has been made by the Passaic Valley Sewerage Commissioners in this project for a trunk sewer to exclude these factories and trade wastes that are likely to affect the integrity of the sewer?

Mr. Riker: The objection is objected to on the ground that it has not yet appeared in this case by evidence as to what character of sewer the Passaic Valley Sewerage Commissioners are proposing to build within the territory of the state of New Jersey, and that this question and this whole line of questions is based upon an assumption which has not been shown to have any existence in the case; I also object to it as immaterial and irrelevant.

3741 The Commissioner: Note the objection of counsel for the defendants.

A. I have seen no published reports setting forth the intentions of the officials of the Passaic Valley District in this regard; I presume, however, that there procedure at the time the trunk goes into commission will not be very different from the procedure adopted in other up to date sewerage projects, namely, to compel the various industrial establishments, where it becomes necessary, to install treatment works which are simple in design, inexpensive to build and economical to operate and in which will be removed from the wastes as discharged those parts which might in a raw state affect the integrity of the sewer.

Q. I understand you found no provision for such exclusion and for such treatment in the plant and specifications and reports submitted to you and which you collected data in reference to.

A. I have seen no such provision, but I cannot conceive of a condition existing here different from that condition in other places with which I have been connected in similar problems.

Q. What provision is made for the exclusion of the trade wastes if the 10% exclusion applies only to factory wastes?

A. Under the term of "Trade Wastes" I include all industrial wastes whether offensive or inoffensive. Provisions made in other places refer to the retention of grease and hair and other suspended particles which might deposit in the sewer or on the sides thereof.

Q. Do you regard it as advisable to absolutely exclude all trade wastes or factory wastes that would menace the integrity of the trunk sewer itself?

Mr. Riker: The question is objected to on the ground that it is immaterial and irrelevant, and has nothing to do with the issue.

3742 The Commissioner: Note the objection of counsel for the defendants.

A. It is perfectly feasible to withdraw from the trunk sewer all the wastes of industrial establishments, but it is not called for, and would place these industrial establishments under an unnecessary burden, and for that reason I see no cause for such restriction.

Q. What provision is made by the Passaic Valley Trunk Sewer Commissioners for the disposition of the 90% trade or factory wastes that will not be carried in this trunk sewer?

Mr. Riker: The question is objected to on the ground that there is no evidence to support the assumption upon which it is based, and that it is immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendants.

A. I do not accept the assumption that 90% of the trade wastes of the district shall be excluded from the sewers, I believe that to be a point which will have to be decided later.

Q. What percentage of the trade wastes, as you now understand the Passaic Valley Trunk Sewer Project, are to be excluded from the

intercepting or trunk sewer, and are to be disposed of otherwise than through the sewage disposal works to be situated somewhere on Newark Bay?

A. It is the present plan to take *take* into the trunk sewer all the offensive trade wastes of the Passaic Valley District; no trade wastes of an offensive character, with the exception of gas house wastes, are to be excluded.

Q. And those that are excluded, how — they disposed of?

A. Those which are not taken into the sewer are composed of wastes in such a high state of dilution, that they may be safely discharged into the river without nuisance, with the exception as before stated of gas house wastes.

3743 Q. What disposition is to be made of the gas house wastes?

A. I know of no provision having been made as a matter of record, but it is probable that these wastes will be cared for on the premises by screening, sedimentation and filtration through beds of coke.

Q. Will screening and sedimentation eliminate the organic matters in solution?

A. Screening and sedimentation have some effect on the removal of dissolved organic matter in sewage.

Q. To what extent?

A. It is difficult to answer that question without first knowing certain set conditions with particular regard to the decomposition of the sewage to be treated.

The size of the screen and the velocity of the flow through settling tanks.

Q. Applying the question to the conditions as you are familiar with them for the sewage disposal of the Passaic Valley trunk sewer project?

A. The percentage of organic matter which will be removed by screening and sedimentation in the Passaic Valley project, or rather at the treatment works near Newark, will be subject to a considerable fluctuation, as has been found to be the case elsewhere. Experiments running over 11 months at Columbus show that the settling tanks did remove at times some of the dissolved organic matter not a large amount but some. In the case of the grit chamber set forth at page 77 of the Columbus report the average removal of dissolved organic matter, during the period of seven months, was very slight, the reduction being from 119 to 115 parts per million. In the case of the tank operating at high velocity from February to June the amount of dissolved organic matter contained in the effluent was two parts per million in excess of that found in the influent.

3744 Q. What kind of tanks were those?

A. Wooden tanks about 40 feet long.

Q. Are those the total dissolved organic matter?

A. They are the dissolved organic matter.

Q. Volatile or otherwise?

A. Volatile.

Q. What was the total of removal of dissolved organic matter?

A. That is the figure.

Q. What is that?

A. I have already given you that, the reduction from 119 parts per million to 115 parts per million.

Q. How was that removed, was it by screening, by sedimentation or by evaporation?

A. By sedimentation alone. I have no records to show the removal of organic matters in a dissolved state by mere screening.

Q. Were you consulting page 77 of the Columbus report then?

A. I was consulting page 77, yes sir.

Q. What does that heading in the tabulation appearing on that page mean, "residue on evaporation", and under which the figure you have just quoted appear, and under the sub-head "Volatile"?

A. In making these determinations it is the custom to use thoroughly clean platinum dishes having a holding capacity of about 130 cubic centimeters. These are thoroughly dried and weighed and placed in a desiccator; the sample is poured into this dish 100 cubic centimeters being the usual quantity and the dish is placed on a steam bath and there allowed to remain until the contents have entirely evaporated. The residue contained within the dish is obtained by again weighing the dish and comparing the 3745 weighing with the dish when clean. The difference represents the total residue of the evaporation. Another sample collected at the same time, or a portion of the sample already referred to, is run through a filter and all suspended matter removed. One hundred cubic centimeters of the clear liquid are then evaporated to dryness in a manner similar to that described above, and the total residue of evaporation again determined. This determination represents the matter, on evaporation, which was in solution in the samples; the difference between the two represents the suspended matter. To determine the volatile matter, the dish after weighing is placed over a burner and read heat applied, usually in a radiator, for a short period of time, several minutes. The dish is allowed to cool and again weighed; the matters which are burned off and which are determined by again weighing the dish and subtracting that result from the previous results before heating, are termed volatile matters.

Q. Mr. Johnson, is any part of the sewage disposal project adopted by the Passaic Valley Sewerage Commissioners contemplating evaporation or filtration for the purpose of removing the dissolved organic matters?

A. I think not, no sir.

Q. My original question was what percentage of the dissolved organic matter would be removed by screening and sedimentation such as is contemplated to be put in use by the Passaic Valley Sewerage Commissioners?

A. I have already answered that by saying there would be some removed, and also by saying that it would be small. Unquestionably there are small quantities of dissolved organic matters which are drawn out of solution and attached themselves to the suspended matter and subside with it. These, as before stated, are small, and it is doubtful if they would amount on an average throughout the year

to more than 5% or so of the whole of the dissolved organic matter contained in the crude sewage.

3746 Q. In your experience is dissolved organic matter more or less putrescible than solid organic matter.

A. Organic matter in sewage which is in a dissolved state is putrescible, and highly so, as is also suspended organic matter present in sewage. It is a further fact that decomposition and ultimate putrefaction of the dissolved matters in sewage, take place more slowly than do the decomposition and putrefaction of suspended organic matters in sewage. It would be difficult to draw a line of comparison between the offensiveness or the putrefaction action on organic matters in suspension and in solution respectively.

Q. The distinction that I requested you to draw was between organic matter in solution and solid organic matter as to their relative putrescibility.

A. I thought I had answered that quite fully, but I will go further. Ordinary sewage contains a certain quantity of suspended matter, it is practically true that fifty per cent of this total organic matter is in a suspended state and fifty percent is in solution. The percentage of mineral matter in the dissolved organic matter is fairly well set forth in the Columbus report on page 77 and page 90. On page 77 in a grit chamber A, it is noted that the sewage applied to this tank contained two hundred and six parts per million of volatile organic matter of which one hundred and nineteen per million were dissolved. Similarly in the case of grit chamber B, the total amount of volatile matter in the applied sewage amounted to one hundred and sixty six parts per million, of which ninety-two per million were dissolved. On page 99 plain settling tank A, the sewage applied contained one hundred and sixty eight parts per million of volatile matter, of which one hundred and four parts were dissolved; in plain settling tank B the applied sewage contained one hundred and sixty four parts per million of volatile matter, of which one hundred parts were dissolved. So that from

3747 these figures we can see that of the total amount of volatile matter contained in sewage approximately sixty per cent is in a dissolved state.

If we take similar result from suspended matters from the sample table, we find in the case of grit chamber A that in the applied sewage the total suspended matter amounted to one hundred and ninety six parts per million and the volatile matter to one hundred and eighty seven parts per million. Similar results in the case of grit chamber B show two hundred and forty-two and two hundred and seventy-four respectively. On page ninety in the sewage applied to plain settling tank A the total suspended matter was one hundred and forty seven parts per million of which sixty four parts per million were volatile. In the sewage applied to settling tank B the total suspended matter was one hundred and thirty four parts per million, of which sixty four parts were volatile. Therefore the amount of volatile matter in the solid matters amounted to about forty per cent.

Q. By volatile, do you mean organic matter in solution?

A. It is a rough determination of the amount of organic matter, yes, sir.

Q. Do organic matters go into solution in their passage through the settling tank?

A. I think not to any marked degree, although that would be true in the case of such matters as are deposited on the floor of the tank and there subjected to bacterial activities in which putrefactive conditions would be set up and maintained. Under such conditions as these in a layer of deposited sludge, the bacterial action would result in the hydroization and gasification of practically fifty per cent of the deposited matters.

Q. What gases would be evolved during such conditions as you have just described?

3748 A. There would be a large variety of gases, but they are principally marsh gases, and possibly some small quantity of sulphurated hydrogen, and maybe, probably, a considerable volume of hydrogen.

Q. How about nitrogen?

A. I suppose some nitrogen might be so evolved, but in the form of ammonia only.

Q. Do you regard sulphurated hydrogen as the most objectionable of sewerage products?

A. It is objectionable, highly so, if present in large amounts but it is true that in the practical operation of sewage work it is next to impossible to obtain a quantitative result as to the amount of sulphurated hydrogen evolved from a sewage tank; the amount is so small that it is only possible to get a quantitative result as a general proposition.

Q. Did you read the testimony given before the Harbor Line Board on the application of the Passaic Valley Sewerage Commissioners for a permit to tunnel under Newark Bay, under the Bayonne peninsula and New York Bay?

A. Yes sir, I read it.

Q. Do you recall a part of that testimony was that paint was blackened on the houses, that rivets were eroded on ships and that the metals on ships were interfered with?

A. Yes sir, I recall that.

Q. Will sulphurated hydrogen blacken lead paint?

A. It most assuredly will, even though present in very small quantities.

Q. So that it is a very deleterious product of decomposition is it not?

A. It is, but it is true as a rule restricted to deposited beds of such organic matter.

Q. It is evolved from the Passaic River at present, is it not?

3749 A. Through the putrefaction of the deposits on the bottom, yes sir.

Q. It is a case of daily and continual occurrence, is it not?

A. It is.

Q. Do you regard it as the most obnoxious product of decomposition changes?

A. I do not think it is particularly objectionable except for the sense of smell; I have no doubt but what it would be regarded as objectionable in large quantities such as are now arising from the shores around New York and in the Passaic River.

Q. On which side of the river?

A. I do not think it attaches to any particular side of the river, I should say both sides, the East River and Harlem and Hudson.

Q. Are they worse on the Weehawken and Hoboken sides than on the New York side?

A. I have been traveling back and forth between Hoboken and New York for some years and it has been my experience that the offense is much greater on the New York side, as it naturally would be.

Q. Have you read the testimony of Mr. Fuertes taken in this present case?

A. I glanced over it.

Q. Do you recall what he described the condition to be in the Hoboken docks or slips or the piers?

A. I should be interested in seeing what he would say in the way of a comparison, I do not recall what he said specifically about Hoboken.

Q. What New Jersey cities contribute to the present condition of the lower Hudson and Upper New York Bay?

A. I suppose the most important are Weehawken, Hoboken, Jersey City and Bayonne.

3750 Q. What is the volume of trade wastes and of sewage contributed by the communities you have just enumerated?

A. I suppose the most reliable data are to be found in the reports of the Metropolitan Sewerage Commission, and I refer to the report of 1910, at page 76, in which the following appears:—

"There were ten cities in metropolitan New Jersey which had populations over twenty-five thousand, in 1905; the largest of these were Newark and Jersey City each of which had populations exceeding two hundred and thirty thousand. The total population of these ten cities was nine hundred and ten thousand in 1905, and will probably be at least one million seven hundred thousand, by nineteen hundred and forty."

Q. Can you make any estimate as to the relative quantities of sewage of trade or factory wastes contributed by these communities into the harbor waters?

A. There have been so many statements made as to the probable volume of sewage discharged into New York Bay at the present time, or more properly into New York Harbor, that I would only add another figure. The facts are I think they are altogether too high as they have been stated, they are out of reason; but referring again to the metropolitan sewerage commission report for 1910, at page 76, I find the following:

"The sewage produced in the Metropolitan District is discharged into the harbor either (a) Directly, near open navigable channels.

as in the case of New York, Yonkers, Jersey City, Hoboken, Bayonne and Elizabeth."

"This is the first time I ever knew Elizabeth came into New York waters in the harbor.

"Or (b) indirectly into these channels by way of the rivers, as is the case with White Plains, Mt. Vernon, Paterson and Passaic."

"The total quantities of sewage discharged into New York Harbor per day, at the present time, are approximately as follows.
3751 In the East and Harlem Rivers three hundred and thirty five million six hundred thousand gallons; into the Hudson River \$64,200,000 gallons; into the Upper New York Bay 104,000,000 gallons."

This is sewage said to be contributed by a total population in the metropolitan district, of five million three hundred and thirty-two thousand persons. This is about the lowest estimate that has been made and corresponds to a per capita flow of a hundred and thirteen gallons per day. Assuming, taking the data shown in the 1910 report of the Metropolitan Sewerage Commission, page 76, that the population of the contributing sources outside of New York City proper, is 1,332,000 this represents a total daily flow of 150,000,000 gallons.

I should say in round numbers that the sewage contributed by Weehawken, Hoboken, Jersey City and Bayonne is 50,000,000 gallons a day. That may be a bit low figure, but it looks reasonable.

Q. Does that include trade wastes as well as sewage?

A. Yes sir.

Q. Are there any more objectionable trade wastes contributed to the harbor waters than those from Bayonne?

A. It is certain that they are bad enough but probably the most offensive trade wastes which are discharged by the Passaic Valley District or New York City are the wastes from abattoirs, of which there are twelve in New York.

Q. How many discharge into the Passaic River?

A. I do not recall that I have the exact number. There are less than twelve. That is as far as I can go.

A recess was then taken.

3752 Q. I do not think you gave me the total volume per day in gallons that you estimated the trade wastes would amount to for the year 1940?

A. As I have stated they have not been estimated; the facts are that the increase in the amount of trade wastes will not, in all probability, be in proportion to the increase in the total sewage flow in the future. A conservative estimate of the total volume of trade wastes of an objectionable character required to be taken into the sewer would be about twenty million gallons per day in 1940.

Q. That would be the total volume per day in gallons?

A. Yes sir.

Q. I asked you on Friday last if you knew how many pounds of silk were manufactured in Paterson in the silk mills, per year?

A. I do not.

Q. Mr. Hazen in his investigation as reported in the report of the joint committee on sewage disposal of the City of Paterson pages 69 to 70, says:—

"In the dye houses of Paterson are handled every year about seven and a half million pounds of raw silk, or two thirds of the whole amount manufactured in the United States. In handling this material the dyers estimate that one thousand gallons of water are used for every pound of silk, or for working days more than twenty million gallons per day, or two hundred gallons per capita for the entire population."

On that basis how large would be the trade wastes of the silk mills of Paterson?

Mr. Riker: The question is objected to because it states as a fact on which the question is based, matter which is not proved in the case.

The Commissioner: Note the objection of counsel for the defendants.

3753 A. The total amount of objectionable trade wastes from the City of Paterson, estimated in the year 1907, was 2,700,000 gallons.

Q. Per day?

A. Per day, in round numbers; therefore the amount of objectionable trade wastes approximate ten per cent of the total trade wastes of the city, placing this figure on Mr. Hazen's statement to which you have just referred.

Q. What would be the entire amount of trade wastes from the silk mills, either objectionable or unobjectionable, per year and per day?

Mr. Riker: If you know.

A. I can do no better than repeat Mr. Hazen's figures which you have just referred to, and which amount to 20,000,000 per day, or 6,330,000,000 gallons per year.

Q. And that 20 million gallons per day from the silk mills alone of Paterson is greater than the entire volume of sewage which you estimated would be discharged from the factories and manufacturing plants of Passaic Valley in the year 1940.

A. In the first place I want to call attention to the fact that in my last answer the yearly volume of total trade wastes from Paterson was figured on three hundred and fifteen working days. In answer to your last question I would say that the total volume of trade wastes from Paterson in 1907 as estimated by Mr. Hazen, is approximately the same in daily volume as that estimated for the entire Passaic Valley District in 1940. In the latter instance however, the total volume of trade wastes refers to objectionable trade wastes; in the case of Paterson it refers to objectionable and unobjectionable trade wastes, of which the former approximate ten per cent of the total.

Q. Will the objectionable trade wastes be among the ten
3754 per cent of the trade and factory wastes to be taken in the trunk sewer, or to be disposed of otherwise?

Mr. Riker: The question is objected to on the ground that it does not appear there is any ten per cent limitation on the waste to be taken into the sewer.

The Commissioner: Note the objection of counsel for the defendants.

A. In the case of Paterson, as in the case of all other communities, I have figured on taking into the trunk sewer all of the offensive trade wastes of the various communities.

Q. How much soap is used per pound of raw silk manufactured in Paterson?

A. You gave me that figure at the last meeting but I have forgotten it.

Q. "A pound or more of soap is used for every pound of raw silk a substantial proportion of which passes off with the wastes; a large amount of extractive matter or gum is removed from the silk." I now ask you if that matter is putrescible and whether or not it contributed in a substantial degree to the present pollution of the river.

A. There appears to be little doubt but that the gum to which you have referred is putrescible, and that it does contribute to the offensiveness of the trade wastes as discharged; the further fact is clear, however, as stated in Mr. Hazen's report, that the total amount of this character of wastes is very small.

Q. Where do the silk mills get the twenty million gallons of water that they consume per day in the silk factories or the silk manufacturing plants of Paterson?

A. They obtain the bulk of this water from the Passaic River above the Great Falls, and from Private artesian wells.

Q. And that would average two hundred gallons per capita for the entire population would it not, as stated by Mr. Hazen?
3755 A. Yes, sir.

Q. Mr. Hazen further states:

"A considerable portion of the water used in the dye houses is ground water obtained from the gravel and rock under the city."

Do you know whether that is true or not?

A. I do.

Q. Is it so?

A. It is, yes. Those are what are known as artesian wells.

Q. Do you know whether or not various chemicals and dyes are used in the process of silk dying and if — will you name some of those chemicals and dyes?

A. I know that there are used in the silk dying industries certain chemicals and dyes such as logwood, tannin, and so forth, but I have not made a list of these chemicals, nor can I give it to you now.

Q. Taking the first operation of silk throwing, do you know whether olive oil and Neatsfoot oil are used in that operation?

A. I do not, I believe that they are; I know that olive oil soap is used largely in the silk dy-ing industry.

Q. Do you know what per cent of the weight of silk they would equal approximately?

A. No, sir.

Q. Mr. Hazen states it to be from one to ten per cent; have you any reason to doubt that?

Mr. Riker: The question is objected to on the ground that it is assumed if Mr. Hazen says so, and there is no proof of it.

The Commissioner: Note the objection of counsel for the defendants.

A. I presume that Mr. Hazen obtained his information from officials at the various silk mills, and presume that the data given by him were based upon facts derived from those sources.

3756 Q. Do you know whether or not this soap is wasted and at the and at the present time goes into the river or into the sewers according to the location of the mills?

A. It is probable that this soap is wasted and that it finds its way either into the sewer or into the Passaic River directly.

Q. Do you know whether that waste from the stripping or boiling off and the soaking of the silk in this strong hot solution of olive oil soap, and washing, is particularly impure and putrescible?

A. All greasy substances are more or less putrescible and objectionable.

Q. In the next operation, the bleaching, do you know what chemicals are used, in that operation and do you know whether or not sulphuric acid and hydrogen peroxide are among those chemicals?

A. I presume that they are, and particularly the sulphuric acid. The usual chemical used in bleacheries is chlorine gas.

Q. Is sulphuric acid injurious to concrete or cement structures?

Mr. Riker: The question is objected to on the ground that it is immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendants.

A. If present in sufficient quantities I have no doubt that it is.

Q. In operating on the lighter shades of silk do you know whether they are weighed with tin and whether the silk is dipped alternately into solutions of stannous chloride and sodium phosphate, and finally passed through a solution of sodium silicate.

A. That is the usual method in the production of a large bulk of the silks of today; it is a development of the last hundred years or less, and has a great deal to do with the life of the product.

3757 Q. Do you know, Mr. Johnson, whether or not stannous chloride and sodium phosphate and sodium silicate are poisonous substances or not?

A. I believe that they are, some of them.

Q. Do you know what the dynamite bath consists in to which the silk is subjected to after the treatment embodied in my last question?

A. No, sir.

Q. Do you know what the red iron bath is to which silk goods are subjected that are to be dyed black and weighted?

A. I can give a guess, but I don't know.

Q. Do you know that after this operation the silk is again passed through a soap bath and then immersed in a bath of potassium ferrocyanide of yellow prussiate of potash?

A. No, sir.

Q. Is potassium ferrocyanide a highly poisonous substance?

A. Yes, sir.

Q. Do you know whether or not the silk after this treatment is immersed in a solution of hydro-chloric acid and after each of these processes the silk is washed and immersed in a bath of gambier and tin chrystals, and that some times catechu is used instead of gambier?

Mr. Riker: If you know, answer whether you do or not.

A. I do not.

Q. You know whether or not these are highly poisonous substances?

A. I do not.

Q. Do you know that tannate of tin is used after the gambier bath and that gambier bath is entirely thrown away and contains both tin and tannate?

Mr. Riker: If you know.

A. I do not know.

Q. Do you know whether or not silk after these processes
3758 is given an organic weighing, and if so state what the organic weighing or weighing is?

Mr. Riker: If you know.

A. I do not know.

Q. Do you know that after this treatment the silk fabric to be dyed white are dipped in a solution of methyl blue, and after dying washed and passed through an acid bath and dried, that color dying is nearly altogether done by aniline dyes and whether these substances are highly poisonous and injurious to concrete as well to the bacterial life expected to subject sewage to biological processes for its purification?

A. I have no knowledge of these processes and restate my opinion that many of these chemicals that you have mentioned are poisonous, but I have yet to be convinced that they are present in sufficiently large quantities to affect the integrity of the sewer; so far as affecting the bacterial contents of the sewage is concerned, it is possible that they may have some local effect as a germicide. In as much as it is proposed to make use — biological processes in the purification of the sewage of the Passaic Valley District this is a factor of no importance; if anything it would be in favor of the Passaic Valley Project in as much as such germicidal action tends to diminish the probabilities of putrefactive action taking place between the point of discharge of such wastes, and the outfall in New York.

Q. Do you know whether or not these spent dye liquors are wasted, and if so whether they are very impure and whether they contain

the soap and the silk gum which is boiled off and which renders these wastes particularly putrescible.

A. I know that the dye liquors, after they have spent their force are wasted, and I know that they are offensive and require to be taken into the trunk sewer. The proportion of these wastes
3759 to the total wastes from silk dy-ing establishments is relatively small, however.

Q. Do you know, Mr. Jhonson, whether with the method of black dy-ing which I have just described, silk when first weighted with red iron is subjected to a bath of gambier and tin and is immersed and washed in a solution of logwood which also contains a large percentage of soap and whether or not this bath after having been used, is wasted as it is foul and should be taken into the trunk sewer?

A. Your proposition sounds reasonable.

Q. Do you know whether or not this last process is followed by washing with wash water which is also exceptionally foul and that it should be taken into the sewer?

Mr. Riker: The question is objected to on the ground that it is at least double and the witness may be able to answer part of it and may not be able to answer other parts of it.

The Commissioner: Note the objection of counsel for the defendants.

Mr. Riker: The question is whether you know certain things, and then whether you conclude certain other things.

A. It is reasonable to assume that the first washing would be somewhat offensive and foul but that subsequent washings, and by that I mean a great many washings, in as much as the quality of the goods undergoing the process depends on thorough cleaning, are not sufficiently foul or highly colored to require that they be taken into the trunk sewer; they may therefore be discharged without offense into the river.

Q. Do you know whether or not the next step after the one I have described is to immerse the silk into a bath of pyrolignite of iron, or black iron as it is called, which serves as a mordant, after which it is washed again and that this wash water is foul?

A. I do not.

3760 Q. Do you know that after this mordanting the silk is then put into a bath of gambier and then into soap and logwood and once more washed and that the final part consists of immersing the silk in a bath of ascetic acid and lemon juice which gives it a scroop and makes it brilliant, and that this bath is wasted and should be put into the sewer?

A. I do not.

Q. Do you know that in jet black dy-ing the weighing is done with tin and silicate and the dy-ing with gambier and logwood, that sumach and nut galls are used, and that the liquor or waste from this first part and the subsequent wash waters are particularly foul and should be carried in the sewer?

A. I do not.

Q. Do you know that in the finishing, printing and final operation gum arabic, glue, starch, dextrine, and similar substances are used?

A. I so not.

Q. From these various operations that we have been describing do you know what the total solid and suspended matters amount to, and whether or not analyses would give 2.05 pounds of total solid matter per pound of silk.

A. According to my best recollection Mr. Whipple and Mr. Hazen stated in the report which you are now referring to that the total amount of spent dyes, wash water and other wastes from two hundred and ninety five establishments in Paterson amounted to 2,000,000 gallons daily. The amount of suspended matter in these two million gallons of offensive wastes which require to be taken into the sewer I have no data on, but I can figure it if you so desire.

Q. Please do so.

A. Mr. Whipple gave this figure as 11 tons of suspended matter per day as being contained in the trade wastes discharged from the silk manufactories, to the best of my recollection.

Q. Do you know Mr. Johnson, whether or not the seven 3761 and a half million pounds of silk dyed per year in the silk factories of Paterson yield thirteen and a half million pounds per year of total solid matter and but six million pounds of suspended matter or thirty seven thousand and sixteen thousand five hundred pounds per day respectively or one hundred and fifty-one and fifty-eight grams per capita daily?

A. I do not.

Q. Do you know what percentage of these solids is organic matter and what percentage mineral matter?

A. I do not.

Q. Do you know whether or not the amount of organic matter discharged from the dye works in Paterson, in the silk factories, is 8,100,000 pounds per year or 22,000 pounds a day or 90 grams per capita daily?

Mr. Riker: The question is objected — on the ground that the witness has already said he does not know.

The Commissioner: Note the objection of counsel for the defendants.

A. I could not check that without figuring.

Q. Do you know whether or not three fifths at least of this organic matter is in suspension and is composed of particles of such size that they cannot be removed except with filter paper?

A. I do not.

Q. Do you know what the organic matters in the silk wastes from Paterson silk manufacturing plants chiefly consist in?

A. Specifically no.

Q. Do you know whether or not they consist of soap, silk gum, waste organic dye stuffs, acids and such like organic compounds?

A. I believe they do.

Q. Do you know that the average weight of soap undred in Pater-

3762 son is more than equal to that of silk, and that seventy five per cent of the soap may be recovered at the works where three and a half million pounds out of the total seven and a half million pounds of silk per year is dyed and that the amount of the other wastes from the dye works is found to be equal to 13,300 pounds per day or 54 grams per capita daily?

Mr. Riker: If you know, Mr. Johnson.

A. I do not.

Q. Do you know whether or not the silk gum amounts to twenty five per cent of the weight of the silk or about 5,100 pounds a day or 21 grams per capita daily?

Mr. Riker: The question is whether you know.

A. I do not.

Q. Do you know what the amount of wastes from the throwing mills are in the silk operations of the silk factories in Paterson?

A. I do not.

Q. Do you know whether one and a half million pounds of silk are thrown every year in addition to the matter we have been speaking of and that five pounds of soap are used for each one hundred pounds of silk and that the total amount of the soap used is seventy-five thousand pounds per year, or two hundred and six pounds per day, in those factories?

Mr. Riker: The question, do you know?

A. I do not.

Q. Do you know any other sewage districts in this country where ninety per cent of the trade or factory wastes is excluded from the sewers?

A. I do not.

Q. How many hours are required in warm weather for sewage to become mal-odorous in the sewers themselves?

A. It depends upon the quality of the sewage initially, the temperature of the sewage and its composition.

3763 Q. Can you give me an average or approximate as to the number of hours, taking sewage of the type of the Passaic Valley sewage?

A. Observations made along these lines in many hundred of samples led me to believe the opinion that a sample of sewage taken from an incepting sewer many miles in length and allowed to stand on a table at room temperature will become mal-odorous in something like twenty-four hours.

Q. Is the sewage likely to become mal-odorous in warm weather while passing through the settling tanks?

A. By reason of the fact that its retention period is one and a half hours as a maximum I feel no apprehension about its growing mal-odorous during its stay in those tanks.

Q. Is the sewage likely to become mal-odorous in warm weather while passing through the long outlet tunnel under Newark Bay and Upper New York Bay?

A. I have already expressed the opinion earlier in my testimony that it will not.

Q. If the sewage is mal-odorous before reaching the settling tanks will it become less so by passing through tanks and this long outlet tunnel?

A. There is a possibility of course that such possibly mal-odorous condition would be increased during its stay in the tanks during the period of time elapsing between its discharge from those tanks and its entrance into the waters of New York Bay. There is however, a possibility of the sewage, while remaining in those tanks, taking up oxygen from the atmosphere which might in some measure diminish these mal-odorous conditions inasmuch as in my opinion the sewage as it enters them and as it leaves them will not be truly septic.

Q. Do you know of any case where sewage has entered into combination, either by absorption or chemical action, with the oxygen of the air in passing through deposit tanks?

3764 A. I know it is a generally recognized theory that oxygen is so absorbed where opportunity is given to subject the surface of the sewage to the atmosphere.

Q. What are the relative capacities of sea and fresh water for absorbing offensive odors of sewage?

A. Generally speaking it is not possible for sea water to contain as much dissolved oxygen as fresh water, therefore its ability or power as a sewage digester is somewhat less.

Q. I was more particularly inquiring as to the relative capacities of sea and fresh water for absorbing the offensive odors that are given off by the sewage in the form of gases during putrefactive changes?

A. Opinions appear to differ in regard to that point, but inasmuch as Oxygen may be absorbed in the atmosphere and the opportunities for that oxygen so absorbed to diffuse throughout the entire vertical plane of the body of water under consideration are greater in the case of salt water than in the case of fresh water, — the evaporation feature plays an important part in the consideration of this question, whereby thorough evaporation, the top stratum of salt water becomes heavier and the air so absorbed is carried down with this heavier stratum as it sinks below the surface.

Q. Do you regard sulphureted hydrogen, menthane and carbon dioxide as gases devolved through putrefactive changes?

A. I do.

Q. Are they as soluble in salt water as they are in fresh water?

A. It is reasonable to suppose that they are not.

Q. Have you ever performed an experiment along these lines to determine the relative solubility of putrescent gases in fresh salt and brackish water?

A. I have not.

3765 Q. Are there other objectionable compounds to your knowledge like indol, scatol, phenol, cresonole, and phosphine found in sewage?

A. They are.

Q. Are those more or less soluble in salt or blackish water than they are in fresh water?

A. As I have already stated opinions differ on this point and I feel in answering this question I can do no better than to call attention to information on this line contained in the 1912 report of the Metropolitan Sewerage Commission pages 47-48 as follows:

The assimilation of sewage matters proceeds satisfactorily only so long as a supply of oxygen is available. When the oxygen becomes exhausted putrefactive changes set in and offensive odors are produced. These odors are particularly disagreeable when putrefaction takes place in sea water. In this case the demand for oxygen, which under ordinary circumstances are stable, are destroyed by the oxygen which they contain."

Another view is expressed by Dr. Addeney and contained in the fifth report of the British Royal Commission on sewage disposal, appendix 6, page 63; Dr. Addeney, who is recognized Internationally as an authority on this question, has the following to say:

"It must be concluded that the rates of carbon fermentation and of nitrogen fermentation in sewage matters were practically unaffected whether the sewage matters were mixed with sea water or with fresh water and kept under the given conditions and at temperatures between 15 degrees and 18 degrees centigrade, and that also the rates of absorption of oxygen by the sewage matters was similarly unaffected.

"It cannot be taken as generally proved therefore that fresh water presented any superiority over sea water in its capacity of bearing pollution within the limits of fouling. It is true that fresh water can hold 20 per cent more oxygen in solution than can sea water, temperature for temperature, and under actual conditions; but against this must be considered the fact that dissolved oxygen is transmitted through di-aerated sea water from the surface downwards about three times more quickly than through di-aerated fresh water.

"It has already been remarked that there seems to be a widespread impression that the odors from over-polluted sea water are more offensive than those from over-polluted fresh water. This impression is probably well-founded since sulphides and possibly organic sulphur compounds are formed in sea water when over-polluted by a reduction of its sulphates. We have not however, observed and offensiveness from sea water when polluted within the limits of fouling, that is so long as dissolved oxygen is present in it, any more that we have from fresh water when pollution within similarly restricted limits."

Q. How does the presence of oxygen in either fresh, salt or brackish water influence the solubility of either indol, skatol, cresonole, pphenol or hydrogen sulphide?

A. It is to be assumed that the solubility of the compounds you have mentioned would be reduced in general proportion to the oxygen contents of the water in which they were deposited.

Q. And if the oxygen contents was low you would expect those

substances to be evolved as mal-odor-us evidences of the sewage condition and its pollution?

A. It — my firm belief that these compounds you have mentioned can only be produced in layers of sludge where putr-active activities are at their height and that in all probability rising to the surface, they would be absorbed by the oxygen contained in the over-lying strata of water.

Q. Are those the only conditions under which they are produced that you know of?

A. I have paid particular attention to the production of such compounds, particularly in connection with studies of the differentiation and classification of bacteria and I believe that these are 3767 the main causes and sources.

Q. In other words you ascribe the production of indol, scatol, cresonole, phosphine and sulphurated hydrogen to an an-aerobic decomposition of sewage deposits, and to that source only?

A. I can conceive of no other condition and in this connection I would like to call attention to certain results obtained in the operation of certain coke strainers used in tests on purification of sewage at Columbus. (See report of Sewage Purification at Columbus, Ohio, page 144). In this report I make the following comments.

"Septic action developed in both strainers soon after they were initially started and preceded therein with varying intensity until the beds were shut down for the last time. Although the beds were drained and allowed to rest for 12 hours each day on the regular schedule of operation, these rests, as well as others were several consecutive days were allowed, did not result in the destruction of the action in the beds, or even in a marked diminution thereof".

"At all times during their operation there was a pronounced odor of sulphureted hydrogen about the discharge pipes in the coke strainers. The cause of this was presumably due to the fact that the intimate contact under highly anaerobic conditions of the sludge in the coke layer and the applied sewage causing a formation of the gas from the decomposition of the organic matter present, and perhaps from the partial reduction of the sulphur in the coke and the sulphates in the applied sewage. The amount of hydrogen sulphide thus formed was in such relatively large amounts that the iron in the sewage and the sludge was insufficient to hold the gas as iron sulphide, as was probably the case in the septic tanks".

Q. Mr Johnson, you have now answered in relation to hydrogen sulphide, what answer do you make relative to indol, scatol, cresonole, phenol, and phosphids? 3768

A. It is my experience that these may be formed either in the presence or in the absence of oxygen due to the activity of facultative an-aerobic bacteria.

Q. Do you know of their development or creation under any other conditions?

A. That is all I have interested my self in.

Q. Would you expect to find them in fresh sewage?

A. I should not expect to find them in fresh sewage in quantities to be perceptible.

Q. Do you know whether or not sulphureted hydrogen, indol, scatol, phenol, cresonole and phosphine are not formed in human intestinal tube?

A. I believe that they are and there unquestionably the cause is anaerobic exclusively.

Q. So that you may have them in fresh sewage?

A. I hardly see the connection between your last question and the present one.

Q. If they are formed in the alimentary canal of human beings how are they excreted from the alimentary canal of human beings if not in the excrements?

A. I should express that belief that as discharge from the human organization into water they are immediately absorbed by the oxygen which that water contains and so disappear.

Dr. O'Sullivan: Read the question.

(The last question was then read.)

Mr. Riker: Read the answer.

(The last answer was then read).

Q. Forming what compound?

A. That I am unable to say. I do know however that I have repeatedly made tests of sewage in an advanced state of decomposition as well as of sewage which has not decomposed, attempting to detect the presence therein of indol for example, and I have never found it.

Q. What test did you apply to determine the presence or absence of indol in fresh sewage?

A. The test prescribed by the Committee on Standard Methods.

Q. What is the result of discharging mal-odorous sewage into sea water with respect to the liberation of those odors?

A. If the sewage at the time of discharge contains volumes of offensive gases, the likelihood of their reaching the surface and there becoming apparent is to be measured by the diluting power of the water into which the sewage is discharged, with particular reference to the amount of dissolved oxygen which that sewage contains.

Q. How can water dilute a gas?

A. Perhaps my answer was not any too clear. I meant by dilution, with reference to the possible disappearance of odors, the absorption of those odors by the oxygen which that water contained.

Q. Is such discharge into fresh water attended with a much less liberation of odors?

A. I think I can answer that question as well as I could previously by stating that opinions differ. Personally I think there is very little difference so long as the oxygen in that water is not completely used up.

Q. Who has made determinations on this point outside of the gentleman whose name you previously mentioned, Dr. Adeney?

A. I presume this has been made a subject for study by many laboratory workers; I am unable to state specifically who, to my knowledge, has done such work however.

Q. Have you ever read the experimental work of Kolkowitch?

A. I do not recall that I have.

Q. Have you ever read the experimental work done for the German Government by Professor Wilhelm on Brackish, Salt and Fresh water conditions?

3770 A. Most of my knowledge of European studies on such questions as these is restricted to the work of Dr. Dunbar of Hamburg, Calumette of Paris, Houston, Reddeal, Adeney and others.

Q. Have any of the men you mentioned outside of Dr. Adeney conducted any experimental work on brackish or salt water and sewage conditions?

A. I could not state positively that Dr. Dunbar and Dr. Kewitch have, but I know that the three last mentioned, Houston, Reddeal and Adeney have done work on brackish water and salt water as well as fresh water.

Q. On what does the elimination of offensive odors from the body of water into which mal-odorous sewage is discharged depend?

A. It depends initially on the amount of dissolved oxygen present in the water, and secondly it depends upon the thoroughness with which the sewage containing these odors may be brought into contact with the oxygen of the water into which they are discharged.

Q. How much sulphureted hydrogen and these other offensive gases mentioned will one volume of fresh water absorb at normal barometrical pressure and 60 degrees Fahrenheit temperature?

A. I could not tell you off hand.

Q. Substituting "sea water" for "fresh water" can you answer the question?

A. I should presume about four-fifths as much as fresh water.

Q. Is the quantity of mal-odorous gases which a liquid can dissolve or absorb independent of the nature or quantity of other gases which it may already hold in solution?

A. I do not quite understand your question. A certain volume of sulphureted hydrogen gas may be made up of a number of gases, it may not be pure sulphureted hydrogen.

Q. Assuming that to be as you state, when will you answer 3771 the question?

A. I should be inclined to the belief that the demand upon the oxygen in that event would be lessened rather than increased.

Q. My question is directed to ascertain the quantity of mal-odorous gases which a liquid can absorb or dissolve independent of the nature or quality of other gases which it may already hold in solution Mr. Johnson?

A. Well, Doctor, I can only answer that question in this way:—

The conditions that you presuppose are conditioned that never obtain throughout any considerable period of time, they are conditions that are changing minute by minute, hour by hour and day by day; the result of today is not the result of tomorrow. In the body of water which we have under consideration, that is to say, Upper New York Bay, there are so many agencies of such a diversified character that come into play and control this whole

question, that to produce it to a precise science is out of the question.

Q. How many gases are held in solution by the brackish water that you found in New York Upper Bay besides sulphurated hydrogen?

A. I cannot tell you; I never made any analyses to determine that point.

Q. Do you regard skatol, cadaverin, mercaptan, and these other compounds that we were considering, as more or less repulsive than sulphurated hydrogen?

A. I expect it is all a matter of taste—or smell.

Q. In your particular case which do you regard as the most repulsive?

A. Well, I do not particularly like any of them, but probably indol is the most offensive; it is customary to consider the odor of indol is similar to a so called fetal odor, but doubtless that so-called fetal odor is caused by a combination of gases and not by any one alone.

2772 Q. Is there any provision made in the sewage disposal works of the Passaic Valley Sewerage Commissioners for the removal of these substances from the sewage to be treated at or near the Newark meadows?

A. We gave some consideration to the feasibility of removing these odors, should they be present, from the sewage before it is discharged into the bay. We were unable to find any feasible method for so doing that would come within reasonable cost. As a matter of fact, so far as I know, this is not done in connection with any sewage disposal project in the world.

Q. My question was for the purpose of determining whether or not any provision has been made for the elimination of these substances, in the sewage disposal scheme proposed by the Passaic Valley Sewerage Commission?

A. And I said, Doctor, that we found no feasible method; beyond that I do not know what the Passaic Valley Sewerage Commissioners propose to do.

Q. Do you attach some importance to the colloidal matters in sewage?

A. Yes sir, I do.

Q. What are colloids?

A. Colloids are sewage or other matters distinguishable from crystalloids, which are present in semi-solution or pseudo-suspension.

Q. Do you make any distinction between mineral, vegetable or animal colloids?

A. Colloids which are usually found in sewage are what you would naturally expect them to be, organic.

Q. How do you distinguish organic from in-organic?

A. Organic substances may be made up of vegetable matter or animal matter.

Q. Is there anything in the organic kingdom that is not found in the inorganic kingdom, any one element?

2773 A. The natural cycle of changes which starts with crude

organic matter, such action as starts with the fall of the leaf from the tree, carried through a cycle of changes, through the ammonia stages, through the stage of nitrous acid and eventually through the state of nitric acid which is salt peter and which in its turn serves as food for growing vegetable life and thereby completes the cycle; therefore you may say directly there is no element in the mineral kingdom that is not found in the animal kingdom.

Q. Have not recent experimental workers translated inorganic matters into organic compounds or compounds identical with non-organic compounds?

A. I believe that is so in the case of the production, of ameboids.

Q. How do you distinguish between colloidal matters and true solutions?

A. From the standard of the anasyist colloidal matters are those matters which are removable by filtration through media of very fine separations, like filter paper for example; a crystalloid will pass through, a colloid will remain.

Q. Name me some of the in-organic colloids?

A. Silica.

Q. Do you regard sulphate of antimony and arsenic and the hydroxides of iron and illuminas as in-organic colloids?

A. I do.

Q. Are these found in the trade wastes we have been discussing of the Passaic Valley Sewerage System?

A. I believe they are present in small quantities.

Q. Do you attach importance to these colloids, and their elimination from sewage effluents?

A. That would depend entirely on the method of the disposal of the sewage if it were proposed to purify the sewage by 3774 screening sedimentation and biolytic filters, then I would consider those compounds, making sure that they were not present in sufficiently large quantities to interfere with the biological action in the filters. In this case where the stipulation calls for screening and sedimentation, I see no reason for withdrawing these wastes from the sewer.

Q. Will you name some of the vegetable colloids, Mr. Johnson, that you would expect to find in Passaic Valley sewage?

A. Bacteria.

Q. Any other?

A. Any organic matter derived from the vegetable kingdom which is present in a sufficiently finely divided state.

Q. Can you give me any of the textile fibers that yield colloidal matters and which you would expect to find in Passaic Valley Sewage?

A. It is possible that there will be found small fibers of matters from textile industries which are so finely comminuted as to remain practically indefinitely, in suspension. Those are termed colloids.

Q. Do not flax, hemp, ramie and jute yield vegetable colloids and are they not used in manufacturing establishments along the Passaic River?

A. I expect they are, yes sir.

Q. Do not wood pulp of various grades yield colloids?

A. They do.

Q. Name some of the animal colloids that you would expect to find in the Passaic Valley sewage.

A. Any animal organic matter, or organic matter derived from some animal source is sufficiently finely divided to remain indefinitely in suspension I would regard as an animal colloid. It is further more claimed that grease, in an emulsified state might be termed an organic animal colloid.

Q. Do the elimination of these colloidal matters and of 3775 organic matters in solution usually interest and offer problems to the gentlemen who undertake sewage disposal?

A. They do, but more particularly in connection with the complete treatment in which biological filters are made use of.

Q. Do the colloidal matters rapidly absorb oxygen?

A. Not very rapidly, no sir; by no means as rapidly as organic matters in solution; the reason is obvious, it is impossible to bring the entire body of the colloid in contact with the oxygen.

Q. Can colloidal matters be removed by screens?

A. Some of them.

Q. Which ones?

A. I think there is no selective action, such particles in a colloidal state as naturally would stick and adhere to larger particles known as true suspended matter can be so removed.

Q. Can colloidal matters be removed by sedimentation and do you regard them as subsidable parts of sewage?

A. In the sense that I have just — forth I do. As a particle of suspended matter subsides to a vertical plane it naturally comes in contact with finer particles which do not so subside and those particles naturally sticking to these larger particles increase their specific gravity and in a large measure accelerate the subsidence of the original particle.

Q. Do you know of any author who has put in print the very thin-s which you have just now testified to, that colloidal matters are subsidable or that they can be removed by screens?

A. I think it is a truism in filtration practice.

Q. Screening I said, not filtration.

A. On page 39 of the Columbus report on sewage purification the following appears under the head of "colloidal matter."

3776 "From a broad practical standpoint colloidal matters may be defined by plain subsidance in a reasonable and economical period of time. Suspended matters of this class are obviously in a very fine state of division and appear *and appear* to exist in a state of pseudo solution of micro-solution".

Q. Is that your definition, Mr. Johnson?

A. Yes sir.

Q. You have a copy of Mr. George W. Fuller's book here, have you not?

A. Yes sir.

Q. Will you turn to page 394 and find that the identical words used by Mr. Fuller have not now been read by you?

A. They have but the further statement is made by Mr. Fuller: "This general phase of the composition of sewage was outlined in the Columbus Report of 1905 on pages 39 and 40 as follows".

Q. Is that definition yours or is it Mr. Fuller's?

A. It is entirely mine. Shall I continue?

Mr. Riker: Have you finished your answer?

The Witness: No sir.

Mr. Riker: Then go on.

The Witness: "Such a broad definition of colloidal matter allows various conceptions as to that portion of the suspended matters in sewage which shall be so classed. These so-called colloidal matters are obviously a function of both the velocity of sewage flow and the period of subsidence".

"Viewing this question of colloidal matters in a rough practical way,—not in the precise terms of the physical chemist—several interesting observations were made in regard to the local sewage".

"Speaking generally, it appears that the Columbus sewage ordinarily contains in the neighborhood of 50 parts per million
3777 of suspended matter which can be removed by subsidence only in parts and with great difficulty in practice. In bottle observations figures one-half of the above have been noted but on the other hand, when the sewage was strong, it seemed hardly possible to reduce the suspended matter by subsidence to 50 parts".

Q. In this Columbus report you dealt entirely with fresh water conditions, did you not?

A. Yes sir.

Q. How do harbors or bays or estuaries where there is a large mixture of salt water and the water is brackish; how does that effect these colloidal matters when they are discharged into it?

A. Bottle experiments conducted by the Massachusetts State Board of Health in Connection with the Charles River Dam inquiry some years ago demonstrated the fact that sewage as discharged into salt or brackish water was subjected to a precipitating action of the salt in the salt water.

Q. What per centage of the dissolved organic matter in sewage is colloidal?

A. I dislike to refer to my own work too much but I would like to call attention to the fact, which you may not be aware of, that these Columbus experiments were conducted in a more thorough manner and on a larger scale than any experiments on the disposal of sewage which had been conducted up to that time and which I believe have been conducted since that time; therefore I consider these results to be virtually standard even though they were obtained under my supervision and direction.

With regard to your question I desire to say that at Columbus we found that of the residuum suspended matter contained in the effluent of settling tanks, which was supposed to be or considered to be colloidal matter, one-half, or 25 parts to the million, was
3778 organic colloidal matter. With 25 parts colloidal matter to start from you may refer to page 28 of the Columbus Report

and there the average sewage is shown to contain a total of 215 parts of suspended matter. Therefore the amount of organic colloidal matter remaining in this sewage after sedimentation was about in round numbers 15 per cent of the total suspended solids contained in the Columbus sewage.

Q. Was the work at Columbus continued by anyone after you had severed your connection with it?

A. My work was done at Columbus, Ohio, incident with the design of the works, but more specifically the design was commenced after the test had progressed sufficiently far to allow final decision to be reached as to the type of works which it would be most advisable and economical for the city to adopt. With the close of the experiments in November 1905 the design of the sewage disposal works was still under way and every important feature had been decided upon. I know of no additional work in connection with the disposal of sewage which was done after my departure from Columbus on November 10, 1905.

Q. Have you read Mr. Hoover's report for 1911?

A. Mr. Hoover's reports refer to the practical operation of the works as finally built, and not to any results which were obtained in the testing station of which I had charge and from the results of which the works were designed and later built.

Q. Does his report on the percentage of purification measured by the oxygen consumed in any way differ from the report you made in 1905?

A. That I am unable to state, although I should not think it strange if it did. The oxygen consumed determination is about the most erratic and unreliable test in sewage disposal that there is.

Q. The highest purification you got there was 35 per cent was it not?

3779 A. So far as the removal of suspended matter was concerned?

Q. Yes.

A. I believe that is substantially so.

Q. And didn't he find it by the oxygen consumed, that that should have been expressed in terms of 28 per cent?

A. I do not care to criticise Mr. Hoover's technique but would call attention to the fact that if he determined the efficiency of the septic tanks by the oxygen consumed result, determined from the crude sewage initially, and in the effluent of the septic tanks, in my opinion it is not possible to draw conclusions for the reason that true oxygen consumed results under such conditions and with such effluents are of little value, being complicated by compounds which are constantly rising from the bottom of the tanks through the overlying strata and passing away in the effluent; I would give no weight to the oxygen consumed determination as shown definitely and positively the efficiency of a tank operated as the Columbus tanks are operated.

Q. Did you find whether or not, in operating the Columbus plant and during this experimental period the larger particles of sus-

pended matter were more, or less, putrescible than the smaller particles of suspended matter?

A. I did determine this point, which is of some significance in connection with the operation of the grit chamber during the first seven months of the test. This so called grit chamber was operated so that the sewage had a period of retention of one and a half hours. During that retentive period and with these low velocities of about one tenth of an inch per second——

Q. What page is that?

A. Page 79.—The deposits instead of being mineral in character as we had anticipated, were largely composed of street sweepings of which of course horse manure played a very important part; these sweepings were composed of large particles of suspended matter. The tank was continually exploding, as we call it, that is

3786 to say these organic matters deposited being for a large part horse manure underwent active putrifaction and came to the surface with the ebullition of gases and so affected the result that we had to shut down the tank and provide a shorter period of flow. In this instance it is clear that the deposit of these large particles, composed as I have said of horse manure, were the responsible agents in our opinion for the speedy putrifaction of the deposits in those tanks.

Q. Then did you conclude that the smaller suspended particles were more putrescible than the larger suspended particles?

A. We concluded from that set of results that this particular suspended matter was very putrescible.

Q. The larger or the smaller?

A. These were the largest particles this sewer contained.

Q. Do you know whether or not Mr. Clarence B. Hoover, in 1911, reports a very different finding after continuing experimental works in the Columbus tanks?

A. I have no knowledge that Mr. Clarence B. Hoover operated the testing station at Columbus; such result as he obtained to the best of my knowledge and belief came from the main works as built later on.

Q. Have you ever read his report for 1911?

A. I get them consistently, yes sir.

Q. Do you know whether or not he found:

“The larger particles of suspended matter contain less putrescible matter readily undergoing bacterial decomposition than is the case with the more finely divided particles”?

A. That is not strange but it is a problem of some size to me, in the face of your statement, to reconcile the conditions in New York Harbor at present, wherein only the heavier particles have subsided and where those heavier particles undergoing putrifaction

have been and are unquestionably the main cause for the unsatisfactory condition in New York Harbor today.

3781 Q. Have you read the report of Mr. Ledderer of the Chicago Testing Station for 1911?

A. Dr. Ledderer?

Q. Yes, on the same line of experimental work as to the putrescibility of the larger or smaller of the suspended particles?

A. I have glanced it over but I have not read it with care.

Q. Do you know whether or not Dr. Ledderer's experiments conform in every particular with the findings of Mr. Hoover at the Columbus plant that the finer suspended particles are more putrescible than the larger suspended particles in sewage?

A. I do not know that.

Q. Are colloidal matters subsidable in sedimentation tanks?

A. Unquestionably.

Q. Let me direct you to page 24 of Mr. Fuller's book, the paragraph beginning with the words:—

"Parts of the suspended matter will float, parts will subside and part is so finely divided that it will not respond to the laws of subsidence or floatation; other solid matter will dissolve in sewage and form what is spoken of as crude solution as distinguished from colloidal matters. In sewage work 'colloidal matters' is used rather loosely; I mean those suspended matters in a state of very fine division which cannot be removed by sedimentation. In practice they exist in pseudo solution or micro-suspension."

"About sixty out of two hundred and ten parts of total suspended matter cannot be practically removed except by filtration or by the aid of coagulants. Suspended matters in sewage may be divided into floating materials which form scum, sub-sidable matters, which forms sludge, finely divided particles which pass through
3782 all screens and sedimentation basins and which are spoken of as non-settling solids, as non-subsidable solids, as colloidal solids, or as solids unresponsive to subsidence."

I ask you if that quotation I have made from page 24 of Mr. Fuller's books, conforms with your experience as to the non-sedimentable and non-screenable condition of colloidal matters?

A. It does precisely. But you have rather passed over the broad point upon which you questioned me in your question preceding your last one. You asked me if colloidal matters could be removed in sedimentation basins?

Q. Yes.

A. I said that they undoubtedly could be; if those basins were long enough and if a period of subsidence was long enough and the velocity of flow was low enough, they would unquestionably subside in time. Mr. Fuller is very clear on that when he states that—

Q. What page?

A. Page 24, what you've just read:—

"In sewage work the expression 'colloidal matters' is used rather loosely; I mean those suspended matters in a state of very fine division which cannot be removed by sedimentation in practice."

I underscore the word in practice."

Q. Such devices as the Passaic Valley Sewerage Commission has submitted to your study and on which you have expressed your opinion, will they remove the colloidal matters to be found in the Passaic Valley Sewage?

A. As I have already said they will remove such colloidal matters as naturally adhere to the larger particles of true suspended

matter in the course of the passage of those larger particles of suspended matter down through the liquid in the tank; the removal, it is true, of colloidal matters will be small by the devices stipulated.

3783 Q. How small?

A. That is impossible to state precisely but it is possible to conceive of conditions whereby these suspended matters will be coagulated by certain trade wastes which may be found in the sewage and so aggregated in larger particles which will subside.

Q. Do you attach much reliance on the amount of work to be expected by the sedimentation tanks as designed by the Passaic Valley Sewerage Commissioners, or rather adopted by them?

A. Such tanks as are stipulated, which will be several feet long, in which the velocity of flow will not exceed 75/100 of an inch per second, I consider will remove a substantial proportion of suspended matters, contained in the Passaic Valley Sewage.

Q. Discharging how much by way of effluent, what per centage?

A. About one half.

Q. Where do you expect the sewage disposal works to be installed?

A. I understand that these works are to be installed on the line of the sewer below Newark.

Q. Has any definite location been indicated to you?

A. I think that the location was pointed out but I do not recall where it was. As I understand it is subject to change.

Q. Has any provision been made in the plans submitted to you for the sewage disposal works to increase the size and capacity of those works?

A. No sir.

Q. How many outlets are there from the Passaic Valley Trunk sewer as it leaves Paterson and between that point and reaching the disposal works, that will allow a mixture of sewage and storm water and trade wastes to escape into the Passaic River?

Mr. Riker: The question is objected to as immaterial and irrelevant and being on matters that does not concern the complainant or its counsel.

The Commissioner: Note the objection of counsel for the defendants.

The further taking of testimony on behalf of defendants was then adjourned until Thursday February 20th, 1913, at 10:30 A. M., at the office of Messrs. Riker and Riker, Newark, N. J.

3785 The Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,

vs.

THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Taking of Testimony at the Office of Messrs. Riker and Riker, Newark, New Jersey, February 20th, 1913.

Before James D. Maher, Esq., Commissioner.

Appearances:

Thomas Carmody, Esquire, Attorney General of the State of New York; William A. McQuaid, Esq., Deputy Attorney; Dr. William J. O'Sullivan, Special Counsel for the People of the State of New York, Complainants.

Edmund Wilson, Esq., Attorney General of the State of New Jersey; Robert H. McCarter, Esq., of Counsel for the State of New Jersey; Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

GEORGE A. JOHNSON resumes the stand:

Cross-examination by Dr. O'Sullivan resumed:

Q. (Last question read to witness.)

3786 A. I don't know.

Q. Are there more than fifty, Mr. Johnson?

Mr. Riker: I enter the same objection as last recorded.

The Commissioner: Note the objection of counsel for the defendants.

A. I have no precise knowledge.

Q. What is the object of these outlets, for what purpose are they designed?

Mr. Riker: The question is objected — as last stated.

The Commissioner: Note the objection of counsel for the defendants.

A. I presume that you refer to storm water overflows which become operative at times of heavy rain storms when the capacity of the sewer would be exceeded.

Q. You do then let the storm waters into the Passaic River and into Newark Bay?

Mr. Riker: I make the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. I have no knowledge of this feature.

Q. What provision is made for the separation of storm waters sewage, and trade and factory wastes that are to be allowed to be discharged through these outlets into the Passaic River and into Newark Bay during a period of storm?

Mr. Riker: The question is objected to on the ground that it contains an assumption of fact which this witness has not testified to and on the ground that it is immaterial and irrelevant in any event.

The Commissioner: Note the objection of counsel for the defendants.

A. I have no knowledge either of present arrangements of the sewer in this regard nor as to possible future arrangements.

Q. Do you know whether or not such arrangements exist
3787 in the present plans and specifications of the Passaic Valley Sewerage Commissioners?

Mr. Riker: He has just said he did not, and I do not know why you want to keep on questioning him when he just this moment said he did not.

Dr. O'Sullivan: I did not so understand it.

Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. I know that the existing sewers discharging into the Passaic River are in some cases sanitary sewers that is, sewers designed to carry only domestic sewage, and in other cases they are built on the combined plan, that is, they are designed to care for the domestic sewage storm water and other wastes which may naturally drain into them.

Q. When these sewers are connected with the trunk sewer or intercepting sewer what provision is made for the escape of storm water during the period of storm?

Mr. Riker: I make the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. I have no knowledge of any provisions of this sort which may have been made or may be made in the future by the Passaic Valley Sewerage Authorities.

Q. Did you examine the plans of the Passaic Valley sewerage Commissioners for this trunk sewer during this month of February?

A. I spent about fifteen minutes glancing over the plans, which was too short a time for me to form any reliable idea of the features of design of the same.

Q. Are the first washings during the period of a storm particularly offensive and putrescible?

A. They usually are and these first flushings are made so by the

3788 large quantities of street wash which contains much horse manure which form no inconsiderable part of the suspended solid matters in sewage which are relatively large in size of particles and which deposit at high velocities.

Q. Where storm waters are provided for to be allowed to escape from a trunk sewer are the arrangements automatic or otherwise?

A. They are automatic.

Q. How many of these automatic devices whether you call them outlets or by passes, are provided for in the Passaic Valley Trunk Sewer Project between Paterson and Newark?

Mr. Riker: I make the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. I do not know.

Q. What is the calibre of the trunk sewer as it comes through Newark on its way to the sewage disposal works?

A. That may have been changed since the plans were prepared in the office of Hering and Fuller in 1907; of that I am not certain. If you wish me to do so, I will look up this point. I have, in what I believe to be a copy of the report of the Passaic Valley Sewerage Commissioners, a statement that the sewer under Newark Bay from the pumping station to the outfall, consists of the following—(Interrupted).

Q. My question was directed to the calibre of the trunk sewer before it reaches the disposal works.

A. I am unable to state that.

Q. Is it over thirteen feet in diameter, Mr. Johnson?

A. I should assume that it was for the reason that the tunnel under Newark Bay is given as twelve feet in diameter and the tunnel across Jersey City is given as 12 feet in diameter and the tunnel under Newark Bay is given as 12 feet in diameter, therefore I should assume that the size of the main outfall sewer as it enters the 3789 treatment works below Newark is in the neighborhood of 12 feet in diameter.

Q. Where are the sewage disposal works to be located, Mr. Johnson?

A. I have no knowledge that the precise location has been fixed, but know that it is to be located on the line of the trunk sewer below Newark.

Q. How near to Doremus Avenue if you know?

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendants.

A. I can give you no more precise information regarding the location of the treatment works than is contained in my last answer.

Q. Where is the pumping station, to be located at the sewage disposal works?

A. I do not know but I presume it will be located at the outfall of the main trunk sewer and at the treatment works.

Q. How many pumping stations will form part of this Passaic Valley Trunk Sewer Project along its course?

Mr. Riker: The question is objected to as immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendants.

A. I had nothing to do with this phase of the problem and therefore am unable to state of my own knowledge. There are according to the data I have before me some eight or more.

Q. Does the discharge of sewage through the pumping stations, these eight pumping stations, aid in comminuting the sewage and making more of the organic matter suspendable?

A. In a broad sense that may be true.

Q. How many connections through inverted syphons are made with the trunk sewer itself, the trunk or intercepting sewers on its way between Paterson and Newark.

3790 Mr. Riker: The question is objected to for the same reason last stated.

The Commissioner: Note the objection of counsel for the defendants.

A. I had no part in this feature of the Passaic Valley sewage project, therefore I am unable to answer of my own knowledge.

Q. From your studies of the Passaic Valley Sewerage Commissioners plans for the disposal works, will you describe these disposal works and as near as you can their location?

A. In the first place I did not interest myself in features of design when I examined the plans in the early part of this month, it was more out of curiosity than any thing else that I looked at them at all. I had intended, and I have followed this decision throughout my testimony, testifying in the light of the stipulation set forth in the agreement between the Federal Government and the Passaic Valley Sewerage Commissioners.

Q. Did the plans and specifications that you examined in 1913 in any way differ from or did they conform with, the plans and specifications as familiar to you and designed by the firm of Hering and Fuller?

A. Not having carefully compared the present plans with those prepared by Messrs Hering and Fuller in 1907 or thereabouts I am unable to answer this question.

Q. Would it be necessary for a sanitary engineer in passing upon the efficiency of a plant, to be familiar with the plans and specifications?

A. In general that is true, but with certain fixed conditions such as are set forth in the stipulation, nothing further is required in my opinion.

Q. What are the fixed conditions in the stipulation which influence your opinion and upon which is it based?

3791 A. The fixed conditions set forth in the stipulation complainants' exhibit No. 135. Under article first it is set forth and stipulated and agreed that the:

"Sewage, waste and other matter passing through the said trunk sewer shall first pass through coarse screenings to remove therefrom all large floating matter, and after passing through such coarse screens shall pass through a grit basin or basins where the heavy matter therein shall be taken out as far as practicable, from which basin or basins the sewage or other matter shall pass through self-cleansing mechanical screens having clear openings of not over $\frac{4}{10}$ of an inch".

Another fixed condition as set forth in the stipulation of complainants' exhibit number 135 is that the sewage after passing the fine screen shall be passed through sedimentation or settling tanks consisting of number of units each approximately 225 feet long and fifteen feet deep; the tank capacity to be such that there shall always be provided a detention period of not less than one hour at the maximum rate of flow of the sewage and a detention of not less than one and a half hours under the average condition of daily flow of such sewage, and that the mean lineal velocities through the sedimentation tanks shall not be over $\frac{5}{10}$ of an inch per second for average flow, or $\frac{3}{4}$ of an inch a second for maximum flow. In addition to the above fixed conditions and in connection with these basins, scum boards are to be provided to retain the floating matter and proper and adequate devices used for the removal of the scum and deposit retained in the settling basins.

The next fixed condition is that the sewage after having undergone this treatment shall be pumped through a tunnel to a point in New York Bay near Robbins Reef Light and there dispersed into the waters of the Bay through a series of outlets discharging forty feet or more beneath the surface of the water at mean low tide.

Another fixed condition is the dispersing grid, which according to the stipulation shall be made by connecting the end of the tunnel with four or more discharge pipes extending across the current placed about 100 feet apart, laid in trenches on the bottom of the Bay and of a size decreasing in diameter from about six feet to two feet; on the top of these discharge pipes there will be a series of not less than 150 tees of a diameter not exceeding one foot and placed approximately ten feet apart. On each of the vertical tees outlets are to be placed and these outlets are arranged so as to discharge horizontally across the current, and the extent of the dispersion area is to be at least $3\frac{1}{2}$ acres of the bottom of the Bay.

These are the fixed conditions from which I have drawn and am drawing, my conclusions in the testimony given by me in this case.

Q. Have you now stated your full knowledge of the sewage disposal scheme or design or plan adopted by the Passaic Valley Sewerage Commissioners for the disposal of the sewage to be conducted in the Passaic Valley Trunk Sewer or intercepting sewers?

A. I have.

Q. What kind of an effluent would such treatment produce?

A. I think I have already testified to the fact, in my belief, that as discharged the sewage will not be normally in a septic condition, at least not highly septic, probably just near the border line. I believe that some of the time the sewage as discharged will actually contain dissolved oxygen; I believe that — the total suspended matters in the crude sewage as received at the sewageworks not more than 50 per cent will remain in the sewage as discharged in New York Bay, and furthermore, I believe that of the fat which the crude sewage originally contains not more than 50% will be contained in the sewage as discharged in New York Bay, and that the fats which remain in the effluent as discharged will be emulsified and of practically the same specific gravity as the sewage containing them, hence their tendency to rise to the surface of themselves and form a slick on the surface of the water, is not good.

Q. How is that effluent to be conducted from the pumping station at the sewage disposal works into New York Harbor.

Mr. Riker: Objected to as immaterial and irrelevant.

The Commissioner: Note the objection of counsel for the defendants.

A. I understand it is to be conducted through a pressure tunnel.

Q. How is that tunnel to be constructed?

Mr. Riker: I make the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. I do not know whether any changes have been made from the original plans of Hering and Fuller, therefore any statement of mine in this connection would be of small value.

Q. Do you know whether the tunnel is to be through rocks or whether it is constructed of masonry or iron or steel pipes or other material?

Mr. Riker: I make the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. As I have already stated, my part of this work did not embrace features of this kind.

Q. Where the matters I have embodied in my last question in the plans and specifications submitted to you in this present year of 1913?

Mr. Riker: I enter the same objection.

3794 The Commissioner: Note the objection of counsel for the defendants.

A. I do not recall that I gave ever seen the specifications, and neither the plans or the specifications were submitted to me for examination; I requested that I be given the privilege of glancing over them, which I did during a period of some 10 or 15 minutes.

Q. Whose plans and specifications were submitted to you in 1913?

Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. I have no knowledge for the reason that the name of the engineer in chief, nor of the designer, did not appear on these plans according to my recollection.

Q. Do you know whether or not the present plans and specifications that were submitted to you in the year 1913 conformed with the outline planned as disclosed in complainants exhibit number 135, on which you state you base your opinion?

A. From what I saw of the arrangement for screens and the general layout of the various tanks, I believe that they do.

Q. Do you know of any where that sewage is disposed of through multiple outlets such as are proposed by the Passaic Valley Sewerage Commissioners?

A. I do not and consider it a refinement, and a vast improvement over methods which have been suggested up to this time.

Q. Has any similar mode of disposing of sewage ever been adopted anywhere that you know of, and then put in operation?

A. I would not attempt to say off hand.

Q. What objection would there be in your opinion, Mr. Johnson, to discharging the effluent produced under the plans as outlined in Complainants exhibit number 135, into Newark Bay?

3795 Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. To begin with, as I think I made it clear, that my testimony in this case has been very largely based upon fixed conditions contained in the stipulated agreement, I find in that stipulation no reference to the discharge of Passaic Sewage treated or untreated into the waters of Newark Bay.

Q. Could the effluent that would be produced and which you have testified could safely be discharged into New York Bay, be discharged without offense or nuisance into Newark Bay?

Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of counsel for the defendants.

A. Under present conditions where the Passaic River receives virtually all of the sewage which could at this time be naturally made tributary to the trunk sewer its digestion in the waters of Newark Bay and the Kill von Kull appears to be quite complete; it is certain that with the exception of such new sea water as enters upon New York Bay through the Narrows, the waters of Kill von Kull, at present polluted by the waters of the Passaic River are purer and in a better position adequately to dilute and digest sewage than any other waters entering the harbor. It is not improbable that the effluent from the treatment works could be discharged into Newark Bay, and for some time at least create no nuisance. The opportunities for the continued discharge of such sewage into New York Bay and its being adequately digested would become less and less as years go by and

there is no assurance that, in 1940, to the best of my belief, Newark Bay could adequately care for the treated sewage of the Passaic Valley District. I have no data on current velocities in Newark Bay, but I am of the opinion that they are much lower than those to be encountered in New York Bay, hence I conceive of the probability that some of the suspended particles remaining in the treated sewage depositing on the bottom of Newark Bay, and in a measure producing and maintaining conditions similar to those now existing near the shore line in New York Bay and the East River. It is certainly clear to me that if the effluent of the Passaic Valley Trunk sewer, after treatment, may be discharged without offense into Newark Bay, the possibilities of its creating offensive discharge into New York Bay as proposed are very much less.

Q. What factors would occasion the less offense in New York Bay that did not already exist in Newark Bay?

Mr. Riker: The question is objectionable and is objected to because it does not appear by any testimony that it is a question of less offense, or any offense, in either body of water. The question therefore is not directed to any matter which the witness has testified to.

The Commissioner: Note the objection of counsel for the defendants.

A. The dilution powers of New York Bay waters are clearly much greater than the dilution powers of the waters of Newark Bay.

Q. On what do you base that statement?

A. Some years ago I made a study of the total discharge of the Passaic and Hackensack Rivers into Newark Bay; as a result of this investigation I estimated that the average discharge throughout an average year of the Passaic and Hackensack Rivers into Newark Bay was 1810 cubic feet per second; during dry years this figure was reduced to 1050 cubic feet per second; during the six dryest months in an average year the discharge was estimated at about 900 cubic feet per second, and during the dryest month at 210 cubic feet per second. Therefore, using the well recognized standard for the dilution of sewage at three feet per second per thousand population the diluting powers of Newark Bay contributed by the fresh water discharge of the Passaic and Hackensack Rivers ranges from a population of 603,000 down to 70,000. It is clear from these statistics that there at the present time exists considerable uncertainty as to whether under the most favorable conditions the fresh waters of the Hackensack and Passaic Rivers would afford adequate dilution of the sewage to preclude the establishment of offensive conditions even during average years; during dry weather periods it would be out of the question.

Q. What do you estimate the tidal prism of Newark Bay to be?

A. I have no knowledge at hand on that.

Q. Does it equal or exceed that flow of the rivers that you have just computed?

A. That I do not know, but as I have stated, it is just as well to make it clear that the fresh water discharge during the six dryest months is not sufficient to care adequately for more than 1/10 of the

population contributory to the Passaic trunk sewer. Therefore any outside assistance from salt water would have to make up this 9/10 deficiency.

Q. In computing the diluting capacity of New York's Upper Bay do you not take into consideration the volume of the tidal prism?

A. I do.

Q. Why don't you equally apply it to Newark Bay?

A. Because I have never paid particular attention to the discharge of sewage into Newark Bay, for the reasons above set forth, namely, that I have restricted myself to the stipulation.

Q. What is the volume of the tidal prism in New York 3798 Upper Bay?

A. In round numbers the volume of water in New York Bay at mean low tide amounts to about 15,400,000,000 cubic feet in the Hudson River, between the Battery and 12th Street 2,490,000,000 cubic feet; in the East River between the Battery and 12th Street, 1,140,000,000 cubic feet, or a total of 19,030,000,000 cubic feet.

Q. What have you stated now in regard to the volume of water in these three areas you have mentioned?

A. The holding capacity of the harbor and of the river between the limits mentioned, at mean low tide.

Q. Does the tidal prism slide backward and forward on top of the mean low water?

A. The tidal prism is approximately 2,500,000,000 cubic feet.

Q. What percentage of the tidal prism represents water that has already been in the harbor, that has gone out on the ebb heavily polluted and returned on the flood filled with this pollution?

A. I have made some computations bearing on this point. In round numbers of the water passing out of New York Harbor on the ebb tide about 51% consists of land water which has entered the bay from the rivers which are contributory to it or been left in the harbor from preceding tides, and 49% *per cent* is sea water. Of the water coming into the harbor on the flood tide 38% is sea water according to my computations, and 62% is land water which has been carried out of the harbor and into the Lower Bay on preceding tides. Therefore this data may be summarized as follows:

	Millions of cubic feet.	
	Ebb tide.	Flood tide.
Sea water	6,020	6,850
Land water	6,290	4,180
Total flow	12,310	11,030

3799 I have assumed that the proportion of sea water lost at sea will be proportionately the same as land water not coming back on this basis I have made the following computations with reference to the proportion of new sea water entering with the tide. Land water 4,180,000,000 cubic feet; old sea water; 4,000,000,000 cubic feet; new sea water 6,850,000,000 cubic feet,

minus 4,000,000,000 cubic feet equals 285,000,000, cubic feet. The per cent of new sea water in this case is about 26 per cent.

Q. Where did you get the data on which you have just made these computations Mr. Johnson?

A. From the records of the U. S. Coast Survey and the published reports of the Metropolitan Sewerage Commission.

Q. What was the date of the report of the U. S. Coast and Geodetic Survey from which the figures were taken on which you made your computation?

A. The data from which these computations *were* made were taken from the reports of the United States Coast and Geodetic Survey which appeared in the 1910 report of the Metropolitan Sewerage Commission page 528 and from the report of Col. Black and Professor Phelps submitted to the Board of Estimates and Appointments March 23d, 1911, Complainants' Exhibit 136, page 20.

Q. Then how much do you estimate the return land and sea water on each flood to have been of water that already had been in the harbor and been polluted before it went out on the ebb?

A. In the case of the ebb tide I have taken, 1,182,000,000 cubic feet as the amount of new land water and on the flood tide 285,000,000 cubic feet of new sea water.

Q. Can you reduce that to percentages; what per centage of the flood represents water that already has been in the harbor whether fresh or salt and which went out on the ebb after being polluted?

3800 A. I figure as before stated that the new sea water which has never before been in the Harbor amounts to about 26%.

Q. Have you read the testimony of General Roberts given for the defendant in this present suit?

A. No sir.

Q. Do you know who General Roberts was or is?

A. I have known but I could not say now.

Q. How do you define the terms you have used "dilution" "diffusion" and "dispersion" relative to their sewage effluent that is to be discharged into New York Upper Bay?

A. I shall have to reverse the order in which you have given these terms and start at "dispersion."

By dispersion I mean the discharge of one liquid into and through another.

By diffusion I mean a more or less mixing of the two liquids.

By dilution I mean the proportion of the diluting liquid to the liquid added to it.

Q. Does the condition of the diluting liquid influence your opinion relative to the effect of dilution upon sewage effluents discharged into the diluent?

A. It affects it in so far as the relative specific gravities of the two liquids are concerned.

Q. How respecting the assimilative properties of water into which sewage is discharged?

A. I suppose, in precise terms, that it should be stated that theoretically that salt water possesses $\frac{4}{5}$ the assimilative power of fresh water for sewage digestion. Up to the point where dissolved oxygen is contained within the body of water sewage, I believe no nuisance will be created; the nuisance then will be restricted to the deposits undergoing putrefaction on the bottom of the bay.

Q. If the dilutent water is already polluted to the fullest extent of its power of assimilation will that influence your opinion 3801 in estimating its diluting power for a sewage effluent about to be discharged into it?

A. The plain facts are in this instance the diluting powers of New York Bay waters have not been reached, any where near. The fact that unsatisfactory, unsanitary objectionable conditions, obnoxious conditions, exist around the shore lines is due to the present improper method of disposal of the sewage of New York City, and perhaps in a far less degree to similar methods adopted by cities in New Jersey located on New York Harbor waters.

Q. How do you distinguish the degree between New York City and the New Jersey riparian cities on New York Upper Bay?

A. It has already appeared in the testimony that the amount of sewage discharged by metropolitan New York was 604,000,000 gallons per day in 1905.

Q. Was that volume of Sewage discharged from Metropolitan New York into Upper New York?

A. The statement in 1910 report of the Metropolitan Sewerage Commission, page 76 is that this sewage produced in the Metropolitan District was discharged into the harbor either directly into or near open navigable channels, or indirectly into those channels by way of rivers.

Q. Do you regard New York Lower Bay as part of the Harbor of New York?

A. I do not know whether it is so considered or not, but the one thing that I was coming to in this discussion was that the population of Metropolitan New York outside of New York proper in 1905 represented only about 20% of the combined population of New York City and districts lying outside the city limites but within the 25 mile metropolitan limit.

(Recess was then taken.)

3802 Q. What percentage of the sewage of Greater New York is discharged other than into New York Upper Bay?

A. The only territory in New York discharging other than into Upper New York Bay is that area tributary naturally to Jamaica Bay and waters lying south thereof.

Q. Does any part of the sewage of greater New York discharge into the Atlantic Ocean itself?

A. I have no knowledge of *their* being any outfalls of size discharging directly into the ocean from New York City.

Q. Does any portion of the sewage of greater New York discharge in to New York Lower Bay?

A. Indirectly I think that all of the sewage of New York City with the exception of that part naturally tributary to Jamaica Bay does find its way into Lower New York Bay.

Q. Is there any direct discharge into Lower New York Bay that you know of from the Greater City of New York?

A. I know of none of any practical significance.

Q. The tidal prism that you have testified to and which you have made computations for, did that relate to average conditions from tidal prism or to any special seasonal tidal prism?

A. I have not the detailed figures before me but am of the impression that the figures given represent the average conditions.

Q. Do tidal prisms in New York Upper Bay vary with the seasons and do they also vary with the phases of the moon?

A. They do.

Q. Within what limits?

A. I cannot state in precise terms what those would amount to although I have studied the question somewhat.

Q. Is the variation a very great or a very small one?

A. That I am unable to say in as much as my investigations only related to studies directed at the location of the highest point north in the Hudson River into which sea water would be carried; the highest point north was fixed during the change of the moon following a prolonged droughth and at a time when heavy winds were blowing from the south.

Q. Have you ever known a condition in New York's Upper Bay where there was no tidal prism for more than one tidal cycle?

A. Where ever there is a rise and fall in the tide it is possible to figure a tidal prism according to my understanding. I know of no such point as you mention.

Q. How far up the Hudson River did you find salt water and does the tidal action reach?

A. Tidal variations are noted as far north as the Troy dam the normal chlorine contents of the waters of the Hudson river were found on the 30th of May, 1903, by me, to terminate 10 miles south of Poughkeepsie at approximately 65 miles from New York.

Q. Have you ever heard of a period in New York's Upper Bay when there was no actual tidal prism for several tidal cycles?

A. I have not.

Q. Do you believe such a condition is liable to obtain or has ever obtained?

A. If you are referring to the entire Bay, I think it is highly improbable that it would ever obtain.

Q. Have you ever made any investigations to determine whether or not the absence of a tidal prism in New York Bay has been recorded within 2 or 3 years?

A. No sir.

Q. You will find, if you do make such investigations, Mr. Johnson, that in December, 1911, for three tidal cycles no tidal prism obtained in New York's Upper Bay?

Mr. Riker: The statement of counsel is objected to, and in the

form of a question, should not go upon the record, as counsel is not testifying.

The Commissioner: Note the objection of counsel for the defendants.

Q. You stated in reply to a question, Mr. Johnson, that you thought that Newark Bay could receive the effluent from the sewage works as are described in Complainants' Exhibit No. 135, and could assimilate or accommodate such effluent with out nuisance or offense for several years, although you did not think it could accommodate that effluent with out offense for as long as the year 1940. Is that right?

Mr. Riker: The question is objected to in the form it is put because it is not in accordance with the testimony given by the witness; the testimony of the witness was carefully guarded and was not in the form nor of the breadth that counsel has assumed in his question.

The Commissioner: Note the objection of counsel for the defendants.

Mr. Riker: A further objection is that if he had so testified the record would show it and he should not be called upon to re-state his evidence.

The Commissioner: Note the further objection of counsel for the defendants.

A. In a very general way it is, but I qualified that statement by calling attention to the probably low velocity of the flow in Newark Bay as being likely to permit at times of the deposition of such solid matters or of portions of them as might escape the treatment works. Furthermore I call specific attention to the diluting powers of the fresh waters of the Passaic and Hackensack Rivers as being entirely inadequate at times of dry years.

Q. For how many years in your opinion could Newark Bay receive the effluent described as capable of being produced by the plant as set forth in Complainants' Exhibit No. 125?

Q. In the first place it is necessary to assume that such deposits as have been forming for years on the beds of the rivers discharging into Newark Bay and on the bottom of the Bay itself will be removed or at least that putrefactive agencies will have ceased. So for as estimating the period of years during which Newark Bay could receive the effluent of the treatment works and digest it without nuisance, not knowing the statistics with reference to the tidal prism, I am unable to answer.

necessary in the case of New York. As one further reason why the

Q. Can you approximate the number of years, Mr. Johnson?

A. Without the tidal prism, I could not, no sir.

Q. In what particular are the sewage disposal works described in complainants' exhibit No. 135 superior to the sewage disposal works of Columbus at the time of your connection with those sewage disposal works in Columbus, Ohio.

Mr. Riker: The question is objected to in as much as it is irrele-

vent and immaterial what the relative values of the two works are unless it be shown that they are to operate under the same conditions and discharge into the same diluting element.

The Commissioner: Note the objection of counsel for the defendants.

A. In answering your question it is necessary to make clear that Columbus is situated on an inland stream and that the effluent of the sewage works is disposed into that stream some 200 miles by water below the point of discharge in the intake of the Cincinnati Water Works. It was therefore deemed advisable to purify the sewage of Columbus somewhat more thoroughly than is considered necessary in the case of New York. As one further reason why the complete work of Columbus were adopted is the fact that it was considered advisable in order to guard against possible litigation on the part of riparian owners below Columbus, to take out of the sewage as much as possible of the suspended matter and to discharge into the river at all times an effluent which would contain dissolved oxygen, which would not putrify and which would not draw on

3806 the dissolved oxygen contents of the river waters to make up any deficiency that might obtain. In New York Harbor conditions are entirely different; the waters are not used for drinking purposes, the shellfish and the fish industry in general has been abandoned; no matter how carefully the sewage is purified that may in the future be discharged into New York waters the fish, and the shell fish industry in particular would have to be abandoned,—could not be considered as safe. Therefore the only think necessary in this proposition is in line with the requirements of the stipulation namely, to remove from the sewage such suspended matters of a sufficiently large proportion of readily oxidized organic matters which might cause an abnormal withdrawal of oxygen of waters of the harbor. In effect all that is required, in my opinion, in the case of the disposal problems in New York waters, particularly in Upper New York Bay is the disposal of sewage in a way which will not establish or maintain aesthetically objectionable conditions. It is not a problem relating to the public health except in so far as the isolated proposition of Jamaica Bay is concerned. There, if it is desired to protect the shell fish, industry, a further treatment with such works as are proposed for the treatment of the Passaic Valley Sewage with hypo-chlorite of lime, will affect the desired end.

Q. From your studies of the plans and specifications of the Passaic Valley Sewerage Commissioners, and particularly as set forth in Complainants' exhibit number 135, in your opinion is the plant to procure the effluent stipulated for in that exhibit as efficient as the plant that was operated in Columbus, Ohio, during your connection with that sewage disposal plant?

Mr. Riker: The question is objected to upon the ground that this witness has already stated that he has not examined the plans and specifications of the Passaic Valley Sewerage Commissioners, but has examined only the stipulation.

It is further objected to on the ground that there is no effluent described in the stipulation in question but that certain results are guaranteed to be produced by subjecting the sewage to such treatment and that therefore the assumptions of the question are not proved as facts in the case and the question is therefore objectionable.

The Commissioner: Note the objection of counsel for the defendants.

A. It is not. The reasons for it have previously been made clear. The thoroughness with which sewage shall be purified is always governed by local conditions.

Q. The results of the work done at Columbus, Ohio, and which were published in the report from which you have read, the report of sewage purification at Columbus, Ohio, dated November 10th, 1905, was that work reported and tabulated in various parts of that report done at a regular sewage disposal plant or done at a testing plant during your connection with the Columbus, Ohio, purification, plant?

A. All of that work was done in the testing station to enable the authorities to decide as to the method which proved, under test, to be the most economical and efficient. The recommendations contained in that report which were based upon results obtained in the testing station were followed in the design of the main sewage disposal works which are now in operation.

Q. After screening and sedimenting the sewage for one and a half hours in the Columbus, Ohio, plant, what was the highest percentage of the removal of suspended matter that you were able to obtain?

A. We made no continuous record of the amount of suspended matters removed by screen; the screened sewage sedimented for a period of one and a half hours showed a total removal of suspended matters of 34% on the average.

Q. After screening the Passaic Valley sewage and sedimenting for a period not less than one and a half hours, as set forth in the stipulation, why do you express the opinion that you can secure the removal of 50% of the total suspended matters?

A. The statement which you have referred to was intended to represent a probable removal of suspended matters by screening and sedimentation and not by sedimentation alone; by sedimentation alone I have assumed the removal of 35%, by screening 15%, a total of 50%.

Q. In operating the Columbus, Ohio plant after screening and sedimenting, the sedimentation period being one and a half hours, how much did you remove of the total suspended matters?

A. During the passage of the sewage through the sedimentation tank, termed "grit chamber", the period of sedimentation was one and a half hours and the removal of suspended matter amounted as before stated to 34%.

Q. Was that sewage, before entering the sedimentation chamber, screened?

A. It was.

Q. Did it pass through three sets of screens?

A. It did.

Q. There was a third set of screens finer than anything stipulated for in complainants' exhibit number 135?

A. The first screen had a clear opening of $5/10$ of an inch the second screen had a clear opening of $5/10$ of an inch, and the third and final screen had a clear opening of .375 inch, which was very slightly smaller than the opening provided for in the stipulated screens for the Passaic Valley District, which provides a clear opening of $4/10$ of an inch.

Q. Is there any where recorded in this Columbus report the fact that you were able to remove 15% by the screening operations at Columbus, Ohio during your connection with the plant?

A. I think not.

Q. Can you refer me to any published report or work on sewage disposal which states that such screen as you have described will remove 15% of the total suspended matter.

3809 A. I have referred previously in my testimony to the results recorded by Professor Doctor Dunbar in which, if my recollection serves me correctly, the statement is made that 28% of the total suspended matter is removed by screens.

Q. Will you please give me the page, Mr. Johnson, in which Dr. Dunbar reports that?

A. Page 257 of "Principles of Sewage Treatment" by Doctor Professor Dunbar and H. T. Calvert. It is necessary to state that the precise removal of suspended matter in terms of percentage removal is not stated by Doctor Dunbar and has been computed by me as follows:

He states—(Interrupted.)

Q. On what page?

A. At page 258—that one pound of material is removed for every 22 to 45 persons, according to the size of the apertures of the screens; on this basis the ratios of a pound of material removed for every 22 to 45 persons are equivalent to 20 to 40 grams per capita daily. For screens of the Hamburg type which provide a clear opening of $4/10$ of an inch, the lower ratio of 20 grams per capita per day has been taken; on the basis of 75 grams per capita per day of suspended matter contributed to sewage, this is equivalent to 26.7 per cent removal.

Q. And that computation you make yourself, do you not, Mr. Johnson?

A. I do.

Q. Is the author of the work that you have just quoted from now, Doctor Dunbar, and engineer?

A. I do not think he could be considered an engineer; he is generally in the possession of the necessary engineering facts which are acquired in the study of sewage disposal problems.

Q. Is Doctor Dunbar an American or a German?

A. It is my impression that he was born in America, but for the past 20 or more years has resided in Germany.

3810 Q. What size mesh did he use in the data which you have quoted from him and which you take as to basis of your computation?

A. The largest size screen to which he referred I have assumed was the Hamburg screen because that is the one which he has studied with the greatest care.

Q. Have you any definite knowledge as to the sized screens that he used?

A. In his discussion he refers to a variety of screens having clear apertures ranging from very large to very small, the smallest probably being that at Dresden.

Q. With what mesh?

A. The Dresden screen is a perforated cloth, the apertures have clear openings of $1/12$ of an inch.

Q. How would that compare with the Passaic Valley mesh, or the mesh of the screen outlined in Complainants' exhibit number 135?

A. It is several times finer; but that screen I did not take into consideration in my computations.

Q. Why do you select the coarsest screens mentioned by Dr. Dunbar, rather than the finer screens mentioned by Dr. Dunbar, as the basis of your computations?

A. In order to be on the entirely fair side and because of the fact that the Hamburg screen is almost precisely, if not exactly, the same size with reference to open space as that called for in the stipulation.

Q. Is Dr. Dunbar's work confined to the operations of a plant or to experimental work, preliminary to the designing and operating a plant?

A. Dr. Dunbar for many years has been the active head of investigations into methods of sewage disposal and as such has made it a life study to keep closely in touch with developments in all branches of the art.

Q. And the data which you used of Dr. Dunbar's, was that data from experimental works in a testing station or through the
3811 operation of plants?

A. I think I am correct in assuming that the data which I have referred to were obtained by Dr. Dunbar in the course of investigations of actual sewage disposal plants in operation.

Q. Was the Dresden plant in operation at the time that book of Dr. Dunbar's was published?

A. I think it was, in part; but I can go even further in connection with the Dresden screen, by saying that Dr. Dunbar, (page 59 of his book) indicated that the removal by the Dresden screen is 43% of the suspended matter in the sewage. Recent inquiry on my part has brought out the fact that these screens actually removed a larger per centage of the suspended matter than that indicated by Dr. Dunbar.

Q. Does Dr. Dunbar, any where in the books you have quoted from, state that he gathered his data from the Dresden plant or that he conducted any of his experiments in the Dresden plant?

A. It is to be presumed that his results were obtained during the

operation of experimental installation at Dresden prior to the publication of his book in 1908.

Q. Are you quite positive about that?

A. I am not.

Q. Are you positive as to whether the screen that he operated with was a perforated cloth or a perforated plate?

A. It is difficult to distinguish between a perforated metal plate or a perforated metal cloth unless the cloth be woven; it is true, in this case, that the Dresden screen is composed of a sheet of metal, perforated with rectangular slots with a clear opening, as before stated $1/12$ of an inch.

Q. Will you describe the construction of these plates or screens, how many of them there are and how they are arranged?

A. I could not tell you that. I know that as a general rule the screens are about 15 feet in diameter and built circular in plan so as to take the entire flow of the sewer. It is not improbable
3812 that they may be made of different diameters to fit the particular sewer in which they are installed.

Q. Are you quite sure that the data which you read from Dr. Dunbar's work and which you took as your basis of computation was not experimental work conducted by him with the view of determining just what character of screen would be most efficient for the Dresden plant?

A. I do not, but I know that these screens have been adopted by Dresden and that they are in operation.

Q. How would the Dresden sewage compare with the Passaic Valley Sewage?

A. I presume it would be in round numbers from two to three times as strong.

Q. And as to freshness?

A. I do not know.

Q. Do you know whether Dr. Dunbar conducted these experiments himself or not?

A. The book is by himself and Mr. Calvert, therefore I presume that the tests were made either by himself or Mr. Calvert or both.

Q. Have you any definite knowledge as to who conducted the experiments that are recorded and which you took as the basis of your computations and as to whether or not there were check experiments made on these which in any way modified them?

A. I have no knowledge of that, but I have kept closely in touch with this phase of sewage disposal matters for a number of years, and I know this view as to the efficiency of the screens at Hamburg that I have expressed is also held by numerous other workers in this field. Mr. Hering, I am certain, is very firmly of the opinion that the Hamburg screen is as efficient as I have stated, if not more so, in fact he favors that screen to the best of my knowledge, in preference to others.

Q. How does the Hamburg screen compare with the Dresden screen?

3813 A. The Dresden screen has very much finer openings.

Q. Have you examined the screen at the Dresden Sewage Disposal Works yourself, personally?

A. I have not beyond the photograph of those screens, which I believe to be authentic.

Q. Is it not a fact that both the Hamburg and the Dresden sewage are fresher and stronger than the Passaic Valley Sewage would be as conducted in this trunk sewer to the disposal works and through the tunnel outward to the outfall in New York Upper Bay?

A. It certainly is stronger owing to the lower water consumption in Germany, but as to its putrescibility I am unable to give you any opinion.

Q. What year did you first become attached to the Columbus, Ohio, sewage disposal works?

A. 1904.

Q. What age were you then?

A. Thirty.

Redirect examination by Mr. Riker:

Q. Have you had access to a series of printed reports of the Metropolitan Sewerage Commission, entitled "Preliminary Report" and issued recently?

A. I have.

Q. Have you examined them?

A. I have.

Q. Do you find in them any proposal for treating the sewage of certain territory within the Metropolitan Sewerage District by means of purification plants?

Dr. O'Sullivan: Objected to as introducing new matter and, not redirect.

The Commissioner: Note the objection of counsel for the complainants.

Dr. O'Sullivan: And also on the ground that it is not relevant to the issues.

The Commissioner: Note the further objection of counsel for the complainant.

A. I have.

Q. Are any of the proposed purification plants recommended by that Commission as efficient as that which is described in the stipulations, Complainants' Exhibit Number 135?

A. The recommendations of the Metropolitan Sewerage Commission with respect to the purification of the sewage of New York city and Metropolitan New York, contemplate the use of what are clearly methods and devices almost precisely the same as those called for in the stipulation in connection with the Passaic Valley project.

Q. Where is the sewage treated in this way to be discharged in a general way, into what waters?

A. I find a reference in the preliminary report number 5 of the Metropolitan Sewerage Commission bearing date September, 1912, page 5, where the following statement is made:

"Moreover it seems certain that the Kill von Kull with its deep water and swift current would provide for many years, if not for all times, a sufficiently favorable place for discharging the sewage from

the areas bordering on Newark Bay and the Kill von Kull, after it has passed through settling tanks."

Q. In your judgment is the Kill von Kull as safe a place for the discharge of that sewage so treated as the waters at Robbins Reef in New York Bay?

A. I do not think so because of the far less favorable opportunities afforded for adequate dispersion and digestion.

Q. Have you seen copy of the stipulation by the State of New York and the Bronx Valley Sewerage Commissioners with the United States Government?

A. I have.

Q. Do you recall that that provides for the removal of 10% of the putrescible matter from the sewage to be treated in the purification works?

A. It does.

Q. In your judgment is that as high a degree of purification as will be the result of the treatment described in the stipulation between the United States, the State of New Jersey and the Passaic Valley Sewerage Commissioners?

A. It is not.

Q. Do you know where that Bronx Valley Sewer discharges?

A. The Bronx Valley sewer plans provide for a trunk line some 14 miles long, extending from the northern limits of White Plains to within 300 feet of the boundary between the Borough of Bronx and Westchester County; the trunk sewer turns then west, parallel to the boundary line, and discharges through a tunnel into the Hudson River; it terminates therein in two lines of 54 inch cast iron pipes.

Q. Is that point of discharge somewhere in the neighborhood of Yonkers?

A. Yes, sir.

Q. What is the material of which the Bronx Valley Sewer is constructed?

A. It is a concrete sewer built of cement, sand and crushed stones, and the size of this trunk sewer ranges from three feet 4 inches at its upper end, to 6 feet 6 inches at Washingtonville, the point of deflection to the Hudson River, where it increases to eight feet.

Q. In reaching the conclusion to which you have testified as to the result of the discharge of the Passaic Valley Sewage treated as provided in the stipulation, I think you have testified that you estimate that 10% of the total flow of the sewer would be trade wastes. Now, Mr. Johnson, assuming that the trade wastes discharged from this sewer are reduced to 10% of the total, trade wastes would that result in a less or greater degree of purity in the sewage treated and discharged at Robbins Reef, from what you have estimated as the amount of trade wastes?

3816 A. I should express the opinion that it would result in a sewage of better character as delivered at the treatment works.

Q. You were asked with reference to the discharge of sewage treated as prescribed in the stipulation, Complainants' Exhibit Number 135 and pointed out the effects of fresh water flow; have you taken into consideration at all in your answers which you have given on

cross examination, the fact that there are other polluting sources of the waters of Newark Bay besides the Passaic Valley?

A. In my assumption I have assumed that all sewage now entering the Newark Bay would be withdrawn and that only *the* treated of the Passaic Valley District would be discharged into it.

Q. Do you know whether or not the city of Elizabeth discharges sewage into Newark Bay?

A. That is my impression.

Q. Do you know whether there are discharges of sewage from Jersey City into the Hackensack River and Newark Bay?

A. Yes, sir, there are.

Q. Do you know whether or not there are other sources of pollution further up the Hackensack?

A. There are, a number.

Q. Then would or would not the removal of the Passaic Valley pollution from the Bay entirely remove the polluting matters from the Bay?

A. It would not.

Q. You have been asked with reference to a report by Messrs. Hazen and Whipple, upon the trade wastes and sewage problem of the City of Paterson; with what view, if you know, was that report prepared for the City of Paterson?

Dr. O'Sullivan: The question is objected to on the ground that the intention behind the report is not relevant to this inquiry.

The Commissioner: Note the objection of counsel for the complainant.

3817 A. It is my belief that this investigation conducted by Messrs. Hazen and Whipple which resulted in the report you have mentioned was made with the view of determining the feasibility and cost of constructing and operating independent sewage disposal works for the City of Paterson.

Q. Do you know where they were to be located?

A. It is my impression that they were to be located below the Dundee Dam.

Q. On what river?

A. On the Passaic River.

Q. Were they too as you understand it, to take care of the trade wastes of the city of Paterson?

A. They were.

Q. And to discharge a treated sewage into the Passaic River which would not pollute the waters of the river?

A. In general terms that is so. I presume what they would aim to accomplish would be the purification of this sewage to a point where it would not render the Passaic River more polluted than it was before it received the purified effluent.

Q. In your opinion would an effluent from the city of Paterson, subjected to the same purification treatment, be as safely discharged just below the Dundee Dam in the Passaic River as at Robbins Reef in New York Bay?

Dr. O'Sullivan: The question is objected to as not being redirect and not being relevant to any issue in this case.

The Commissioner: Note the objection of counsel for the complainant.

A. If the treatment works for the purification of Paterson sewage were of the type called for in the stipulation (Complainants' Exhibit No. 135) for the entire Passaic Valley District, it is my opinion that the effluent of these works could not be discharged safely into the Passaic River below the Dundee Dam without creating a nuisance.

3818 Q. If it be a fact that there are tidal periods in which there is no tidal prism in New York Bay, what effect would that fact have upon the conditions created by the City of New York through its method of discharging its sewage into New York Bay as to rendering it more or less injurious than it is under normal tidal conditions?

A. Under such conditions as those the existing unsatisfactory condition near the shore line would be materially increased in intensity.

Q. Returning with one further question to Newark Bay as a body of water into which treated sewage may be discharged, as to relative depth and the difference in New York Bay would the conditions in New York Bay at Robbins Reef have any influence on the question as to which is the better disposal ground?

A. The depth at which the sewage is discharged has a great deal to do with the efficiency of the dispersion of the sewage; the deeper the better the results are bound to be.

Q. Have you any knowledge of the depth of the channel in Newark Bay?

A. I have not except in a general way; I have passed through Newark Bay in a tug boat and at that time the waters were sufficiently shallow throughout practically the entire length of the Bay to allow the propeller to draw up to the surface volumes of black sludge.

Q. I draw your attention to Complainants' Exhibit No. 135, and particularly to this statement in the stipulation; "After passing through such coarse screens the sewage shall pass through a grit basin or basins where the heavy matter therein shall be taken out as far as practicable, from which basin or basins the sewage or other matters shall pass through self cleansing mechanical screens, having clear openings of not less than 4/10 of an i-ch." Do you or do you not understand that that is a limit and not a requirement as to exact size?

A. That is precisely the case.

3819 Q. If that mesh should not prove efficient, do you or do you not understand that a mesh of smaller dimensions would be a requisite lawful additional arrangement which the stipulation provides shall be used if necessary to produce the guaranteed results?

A. That is my opinion.

Recross-examination by Dr. O'Sullivan:

Q. Do you understand, Mr. Johnson, that the 4/10 mesh, 4/10 of an inch, to be the maximum or the minimum to be employed by the Passaic Valley Sewerage Commissioners?

A. I understand that to be the maximum size of apperature called for in the stipulation.

Q. What provision in Complainants' Exhibit No. 135 do you find for the use of a finer mesh?

A. I believe that this point is adequately covered in articles 2 and 5 of the stipulation.

Q. In the article second, appearing on page three of the stipulation provision is made, is it not, that either through compliance with the requirements of the immediate preceding paragraphs, or through requisite lawful additional arrangements there shall be the thing stipulated for, do you so understand it?

A. Yes, sir.

Q. What are the requisite additional lawful arrangements?

A. It is my understanding that the War Department of the Federal Government is the supreme authority in regard to such matters as this; if, in my judgment, the devices installed by the Passaic Valley Trunk Sewer District shall not effect the results called for in article 2 of the stipulation, as I personally believe they will, it is within the authority of the Federal Government to place still further restrictions on the matter in which the desired result shall be obtained.

Q. Do you make any distinction, Mr. Johnson, between
3820 "Requisite additional arrangements" and "Requisite lawful additional arrangements" in your interpretation of Complainants' Exhibit No. 135?

A. To my mind they are synonymous as applied to the authority of the War Department of the Federal Government.

Q. Conceding that they would be requisite how would you determine whether they were lawful or not, these additional arrangements to secure the stipulated results?

A. It appears clear to me, as before stated, that the Federal Government is the deciding power.

Q. And that the municipalities and town ships entering into this contract would have no alternative but to obey, is that your interpretation?

A. The Federal Government exercises jurisdiction over the waters of New York Harbor and I see no reason to believe that they would not be perfectly justified under the law in placing any further restrictions they might see fit to place on the manner of treating the Passaic Valley Sewage.

Q. I will repeat the question. (The last question read.) I ask you if you can give me a more direct answer.

Mr. Riker: The question is objected to as calling for a legal conclusion by this witness as to matters which he does not claim to be an expert on and cannot be.

The Commissioner: Note the objection of counsel for the defendants.

A. Undoubtedly such a decision would be arrived at through co-operation between the Federal Government and the interested municipalities.

Q. I ask you if you can give me a more direct answer to my question and ask that it be read again.

A. That is the most direct answer I can give you.

Q. What is the debt limit of the City of Newark?

Mr. Riker: What is the question.

Dr. O'Sullivan: What is the debt limit of the City of Newark?

3821 Mr. Riker: If you know.

A. I do not know.

Q. What is the debt limit of the City of Paterson?

A. I do not know.

Q. What is the debt limit of the City of Passaic?

A. I do not know.

Q. Can you tell me the debt limit of any of the municipalities or townships who have already entered into contract with the Passaic Valley Sewerage Commissioners?

Mr. Riker: The question is objected to as being immaterial and irrelevant, not relating to any issue in any way, and apparently based upon a misconception that debt limits in the State of New Jersey are constitutional matters not subject to alteration by legislation.

The Commissioner: Note the objection of counsel for the defendants.

A. I cannot.

Q. Can you tell me the extent to which the Governing powers in any one of these cities or municipalities can contract or authorize debt in relation to the Passaic Valley Sewage Problem?

Mr. Riker: The question is objected to as this witness does not profess to be an expert in law.

The Commissioner: Note the objection of counsel for the defendants.

A. I cannot.

Q. Would it be necessary for you to know these facts before you could determine whether a requisite additional arrangement was also a requisite lawful additional arrangement, and before answering questions along that line?

A. It would, but the facts are clear to me, and they appear throughout my entire testimony that the treatment of the Passaic
3822 Valley Sewage according to the stipulation will be sufficient to preclude offensive conditions being established and maintained in New York Bay.

Q. How about Newark Bay in case the same effluent was discharged into Newark Bay?

Mr. Riker: The question is objected to as immaterial.

The Commissioner: Note the objection of counsel for the defendants.

A. I have already answered that question in as great detail as I am able to.

Q. Mr. Johnson, will you compare complainants' exhibit No. 177 with the complainants' exhibit No. 135 and indicate wherein there is superior treatment for the Passaic Valley Sewage to that afforded the Bronx Valley sewage?

A. The stipulation and agreement in the case of the Bronx Valley Sewer is more specific in some particulars than is the stipulation in the case of the Passaic Valley project, and in this connection I refer to article first of complainants' exhibit No. 177 wherein it is set forth that the plan for the partial purification of the effluent of the Bronx Valley Sewer system by screening and sedimentation shall have an efficiency sufficient to remove and it shall at all times remove from such effluent enough of its putrescible contents to purify the same to the extent of ten per cent upon an absolute putrescibility scale. It is my opinion that in the case of the Passaic Valley project this result will not only be reached but exceeded.

In article four of the same exhibit I note that the Federal Authorities shall have full opportunity to inspect the construction of the proposed purification plant and the condition and working of the entire system in order to determine whether the terms of the provisions therein are being observed in all respects, and to this end the Commissioners (presumably the Bronx Valley Sewerage Commissioners) shall render such expert or other assistance as
3823 they may request.

The Secretary of War at all times shall have the right to determine whether such terms and provisions are being complied with and upon notice from him that they are not the Commissioners or their successors shall forth with do whatever may be necessary in order to affect compliance therewith.

This is in line with my interpretation of the Passaic Valley stipulation.

Q. Do you know who drew those stipulations, the engineers who were in charge of the stipulations, and whether they were the same engineers or not?

A. I should be inclined to the belief that they probably were consulted.

Q. Look at the results guaranteed in the two exhibits, complainants' exhibit No. 177 and complainants' exhibit No. 135 and see which is the most stringent in its terms?

A. I will express the opinion that the stipulation in the case of the Passaic Valley Trunk Sewer is the more stringent.

Q. Based upon what fact or facts?

A. It is specifically stated in the stipulations governing the Bronx Valley project, complainants' exhibit No. 177, that in connection with the absence of deposit in the waters of the Hudson River from the effluent of the said sewer, and with regard to the

absence in the waters of the Hudson River and its vicinity of any odor due to the putrefaction of organic matter, the final decision with regard to these features rests with the Secretary of War, and exercising a reasonable discretion; I believe perhaps that is a feature of some *some* minor importance but it is not so stipulated in the Passaic Valley stipulation, although it is to be inferred.

Q. From what would you infer that in the case of the Passaic Valley Sewage effluent?

3824 A. I would infer it from what I have already said, that the Federal Government is a supreme authority a court of last resort.

Q. And even though it be not expressed in terms you would concede that they have the power and the right, is that it?

A. Yes sir I would.

Q. How does the sewage to be transported in the Passaic Valley trunk sewer compare to the sewage to be transported by the Bronx Valley Trunk Sewer as to the character of the sewage?

A. There are many common features in connection with the two projects. Namely, the Bronx sewer is 14 miles long from its upper end to the boundary line between the Borough of Bronx and Westchester County; the total length of the Bronx Valley Sewer is not materially shorter than is the Passaic Valley Sewer, although perhaps that is a little too strong. The total length of the Passaic Valley Sewer from its uppermost end to the point of discharge in New York Bay being some 26 miles. The Bronx Valley Sewer being approximately 17 or 18 miles. The sewage is discharged into the Hudson River near the boundary line, and just north of the limits of New York City, through a tunnel and at the river bank it terminates in two lines of cast iron pipe, and extends about 500 feet from the shore and discharges in 40 feet of water; which is precisely what is proposed in the Passaic Valley project.

I see very little difference in the two with the exception that the sewage is pumped in the case of the Passaic Valley project.

Q. I asked particularly relative to the character of the sewage to be transported by each of these sewers, how would they compare?

A. That I could not state in precise terms. I understand that in 1910 the population of the district tributary to the Bronx Valley sewer was in round numbers thirty five thousand and that the ultimate population to be provided for by this sewer is 680,000 people.

3825

Q. In what year?

A. I do not know that, that is the ultimate capacity of the sewer.

Q. As to the character of the sewage itself, Mr. Johnson, whether it is residential, or trade wastes, or factory wastes, or all three, how do they compare, the Bronx Valley Sewage with the Passaic Valley Sewage?

A. The area drained contains such places as White Plains, Scarsdale, Yonkers, Tuckahoe, Bronx Valley, and Mount Vernon; there are numerous industries in the district and it is probable that the percentage of trade wastes will be reasonably large as compared with the total flow of the sewage from the present district.

Q. Have you made an effort to compute the amount, or the relative proportion of trade wastes to be accommodated by the Bronx Valley Sewer?

A. I have not.

Q. Do you know who the consulting engineer in charge of the enterprise was?

A. I know there are several, I do not recall now the one to whom you probably refer.

Q. Do you know whether Mr. Nicholas S. Hill was or was not?

A. He had a great deal to do with it.

Q. Did you read his testimony as given in this case?

A. I do not recall that I did.

Q. Do you recall whether or not he stated that the trade wastes were practically negligible and that the entire sewage flow was from residential districts?

A. Not having read his testimony I am unable to answer.

Q. Do you know as a matter of fact whether the trade wastes are insignificant or not to be accommodated by the Bronx Valley Trunk Sewer?

A. I do not.

Q. Can you name any industries in the Bronx Valley Trunk Sewer district which would be likely to contribute trade wastes or factory wastes?

A. I have never paid any particular attention to the industrial life of these communities.

Q. These communities contributing to the Bronx Valley Trunk Sewer, do you know whether or not they are sewered on the combined sewer system or on the separate sewer system?

A. I do not.

Q. Do you know what the size of the Bronx Valley Sewer is as to its calibre and as to the amount of sewage that it is capable at maximum of transporting?

A. The concrete main trunk sewer is 6 feet 6 inches in diameter at its upper end, and increases to 8 feet at the Hudson River.

Q. How does the Passaic Valley Trunk Sewer compare in its length and size or calibre with the sewer which you have just described for the Bronx Valley.

A. Its calibre is about 60 per cent greater to the best of my knowledge, and it is several miles longer.

Q. As to the volume of sewage to be transported by each, how do they compare?

A. The Passaic Valley Trunk Sewer is designed on the basis of caring for a population of 1,600,000 people; the Bronx Valley sewer is designed on a basis of caring for a population of 680,000 people.

Q. Is the sewage collected from the combined system harder to be treated than the sewage collected by separate systems?

A. There are many things to be said in that respect; volume for volume the combined is easier to treat. But there is one feature which has a great deal of significance and in my opinion plays no small part in the offensive condition which now exists around the shores of New York, and that is this, that a conservative estimate of the total number of horses in New

York is one hundred and fifty to two hundred thousand; the excrements of a single horse is equivalent to that of ten men therefore we have street wash going into the harbor now in New York alone containing the excrements of horses equivalent to the discharge of wastes of a million and a half to two million people. That matter is always found in combined sewage systems; that it is readily deposited at high velocities of flow is demonstrated by the results obtained at Columbus, to which I have already referred; its effect on the putrescibility of the deposits gathering on the floors of these tanks has been amply shown; it is doubtless in all cases highly polluting.

Q. What is the average age of the sewage of New York City, Mr. Johnson?

A. For the most part the sewage of the Borough of Manhattan is discharged into the New York waters as fresh owing to the short sewer line.

Q. Why is combined sewage easier to treat than separate sewage, sewage collected by separate systems, Mr. Johnson?

A. Because it contains, volume for volume, less organic matter if we exclude consideration of the excrements from horses.

Q. How would you identify the odors or injuries that might come from the Passaic Valley Sewage being discharged into New York Upper Bay from injuries from other sewages which find their way there?

A. I think the best way to settle that fact would be the demonstration of the fact that the discharge of the Passaic Valley Sewage into the Bay at Robbins Reef Light did not make conditions in the Bay worse.

Q. How would you determine whether they were worse or not?

A. New York sewage has so badly fouled the harbor at
3828 the present time that it would be mighty hard to draw the line of distinction.

Q. In that fouling condition have the riparian cities of New Jersey contributed in a large or small measure?

A. I think that the most conservative statement that could be made, and the most liberal statement in that regard, would be that the other communities than New York, the sewage of whom ultimately reaches New York Bay, represents not more than 15% of the total.

Q. Does that generally measure the amount of pollution of a community the actual number of people in that community?

A. It does.

Q. Do particular forms of trade waste exaggerate the numbers to the extent of greater pollution, from smaller communities, than from larger communities in purely residential districts contributing domestic sewage.

A. So far as the digestive properties of the water are concerned that is true.

Q. What is the shallowness that you alluded to a moment ago in Newark Bay *do to now*?

A. Presumably to the accumulation of sewage sludges on the bottom.

Q. Do you know of any contemplated dredging of Newark Bay to fill up the Newark meadows?

A. I believe there is a movement on foot, on the part of the Federal Government which might result in some such work as that.

Q. Would that increase the capacity of Newark Bay if it was dredged to any considerable extent and increase its diluting capacity?

A. So far as the incoming salt water is concerned, yes sir, but it would also lower the velocity of the flow out of the Bay and possibly allow of the deposit of offensive organic matter, such as is
3829 true in the case of New York, but such as will not be true in connection with the discharge of the Passaic Valley sewage, which is beyond the limits of possibility owing to the existing velocity of the channel in New York Harbor, and the velocities in the tanks where the sewage is treated in the treatment works near Newark.

In the report of the superintendent of the U. S. Coast Survey, 1873, page 129, the average velocity of flow of the tidal stream is given as 1.49 feet per second, as the maximum, and 0.29 feet per second as the minimum on the flood tide, and as 1.80 as a maximum and 0.52 per second as a minimum on the ebb tide. Observations made by the Metropolitan Sewerage Commission (report of 1910, page 155) give velocities as follows: maximum velocity 3.4 feet per second on the ebb tide, 2.7 feet per second on the flood tide, and the mean velocities are given as 2.07 feet per second on the ebb tide and 1.61 feet per second on the flood tide. It is unnecessary for me to draw attention to the fact that in the treatment tanks where the sewage of the Passaic Valley District will be retained for an hour or more the maximum velocity of flow in those tanks under the stipulation shall not exceed 0.625 feet per second.

Q. What has the velocity in the detention tanks got to do with the tidal current in Upper New York Bay?

A. They have this to do with them in my opinion:

It appears clear to me that the treatment given the sewage at the proposed works near Newark will result in the removal of all or practically — of those particles of suspended matter which will subside in one hour in a tank where the lineal velocity of flow does not exceed 6/100 of a foot per second; it is safe to say that at no time do the currents in New York Harbor show velocity anywhere near approaching this low figure; it seems plain to me, therefore, that such suspended matter as the sewage may contain as is
3830 discharged from the treatment works will never subside in the harbor but eventually be swept out to sea and permanently dispersed without nuisance.

Q. How long are sewage matters retained in New York's Upper Bay before reaching the outer waters of the ocean?

A. Some of the matters in New York sewage a large proportion of the suspended matters, are retained in New York Harbor indefinitely, according to the present method of discharge of sewage into New York Harbor.

Q. What velocity did you find in the current in New York Upper Bay during slack water?

A. The minimum harbor velocities through a complete vertical section may possibly average a somewhat lower figure than the minimum figure above given; slack water does not last for more than ten or fifteen minutes; that is the time of readjustment; at no time in the harbor, and especially is this true at Robbins Reef Light, is there any probability that there is no velocity of flow north or south.

Q. For how long a period during the 24 hours have you got slack water?

A. It is doubtful if anybody really knows because of the shifting currents at different depths in the harbor.

Q. The current velocities which you have given for New York Harbor for the year 1873, have those been altered or modified in any way that you know of?

A. I judge from the data which I have already read into the testimony as being secured by the Metropolitan Sewerage Commission in their 1910 report, that the velocities of flow, contrary to what naturally would be expected, have actually increased.

Q. When was the data that you refer to as collected by the Metropolitan Sewerage Commission gathered, during what year?

A. I presume in the year 1909, the year previous to the publication of the results.

3831 Q. When was the Ambrose channel opened for navigable purposes?

A. I do not know.

Q. Do you know whether or not it has altered the velocity of the currents in New York Harbor?

A. It is possible that it has diminished those velocities somewhat but the margin is too wide to make that a factor of significance.

Q. In relation to the condition that I directed your attention to a little earlier as to the absence of a tidal prism how would that affect those velocities?

A. If there is an absence of a tidal prism, which is a condition exceedingly hard to contemplate, these velocities will be altered materially; but the matters which might under these extreme conditions be deposited from the Passaic Valley sewage would be so small and so light that succeeding tides following the absence of tidal prisms would undoubtedly dislodge them from the harbor bottom and carry them out into the sea.

Q. How high does the underrun reach from the bottom of the main ship channel towards the surface of the bay?

A. I do not think it is possible to fix an absolute point.

Q. Approximately how high would it reach in the ship channel on an ebb tide?

A. On an ebb or on a flood tide, Doctor?

Q. My question said ebb, and I ask you now if you can get an underrun of a flood tide?

A. There is no question about it.

Q. That you have an underrun and a flood tide at the same time?

A. Yes sir.

Q. What do you understand by underrun, Mr. Johnson?

A. I mean a current velocity at the bottom or near the bottom at any point beneath the surface that is greater than the surface velocity.

2832 Q. Do you have an underrun during the ebb tide?

A. It is possible.

Q. Do you know whether it is a fact or not in the ship channel in Upper New York Bay?

A. From the observations I have made on the question of the diffusion of salt water through fresh water, I think it is possible in a restricted sense to have an under current both on the ebb and the flood tide.

Q. Will you describe the under run which you said you made observations on, Mr. Johnson?

A. I have not said that I made observations on the underrun.

Q. Describe the under- as you understand it.

A. As the flood enters the harbor through the Narrows it is conceivable, due to the higher specific gravity of the salt water entering that that water will hug to the bottom or the lower strata, and so be carried a further distance north than the upper strata composed of fresh water or brackish water. At the northern most point and at the change of the tide, according to my interpretation of the phenomena the surface will exceed in velocity the under run, and there will be a tendency to draw to the surface the under run and thereby effect the mixing.

A. Have you now described an under run on the ebb tide?

A. I am setting forth my opinion as to the probability of there not being a very strong under current; it is very probable there is such an under run.

Q. Will you now describe the under run as you understand it on the flood tide.

A. That is just what I have described.

Q. Then will you describe the under run on an ebb tide?

2833 A. It is my belief that on the ebb tide the swiftest currents are found normally at the surface and that the underrun, if such exists, as probably does, is flowing at a lower velocity than the surface current.

Q. And moving in what direction?

A. South.

Q. The underrun of the ebb tide moves south in New York Upper bay, is that correct?

A. If the water happens to be flowing south. But if you take as a fixed condition that the tide is in ebb when the surface water is flowing it is conceivable and probable that the salt water at the bottom, or the under current, may still be running north while the surface currents are proceeding south.

Q. Do the surface currents on the ebb tide and the under-run on the same condition of the tide, go in the same or opposite directions?

A. Just preceding and following a turn of the tide at the surface

they may be going in opposite directions; ultimately they run in the same direction.

Q. While they are running in opposite directions; how high is the ship channel does the underrun rise, what distance from the bottom of the seventy-five foot channel, if that is the depth, would the under run be found?

A. I could not tell you.

Q. You mentioned as a factor in dispersion in discussing the discharge from the Passaic Valley trunk sewer in New York's upper bay; I ask you how the one factor of the depth itself will aid in the dispersion?

A. It has a great deal to do with it; most sewer outfalls at the present time discharge at or near the surface of mean low water; it is the more common practice nowadays to locate the outfalls at a reasonable depth beneath the surface; that was done in connection with the Bronx Valley Sewer, and it is referred to repeatedly by the Metropolitan Sewerage Commission according to my understanding.

3834 Q. Will not sewage always rise no matter at what depth it is charged when discharged into brackish water?

A. Crude sewage, yes, sir. But I have already called attention to the fact that the diffusion of fresh water through salt water is very rapid.

Q. They reports which you introduced relative to the Metropolitan Sewerage Commission, were these preliminary reports?

A. They were.

Q. Have they been acted upon in any way?

A. They formed the basis, according to my understanding, for the final report; they are issued that their contents may be of early service without waiting for the publication of the

3835 final report.

Q. And commend methods for sewage disposal?

A. That is not the only place where reference is made to this method of putrefication. I refer you to the regular report of the Metropolitan Commission of 1912, at page- 69 and 70, where the following statement is made:

"It is evident from the studies made by the Commission that large quantities of sewage can be assimilated by the waters of the harbor without risk of creating offensive conditions and if the dangers — still lie in bacterial impurities be disregarded it will be possible to discharge large quantities of sewage from which the most objectionable matters have been removed, if into these water without injury and with out excessive cost for public works." The Commission considers that in many parts of the city the construction of disposal works which makes use of the principles of screening and sedimentation in combination with outlets which will secure a prompt diffusion of the treated sewage in the water is the remedy now required, and that these works should be so built as to form a more extensive and composite plan for the exclusion of sewage from the harbor if greater protection should be needed in the future."

1836 Q. The matter which you have just now quoted from the Metropolitan Sewerage Commission report for 1912, and the other matters which you have alluded to as the preliminary reports, do these contain final details relative to sewage disposal or are they merely recommendations as to a line to be adopted towards a final system of sewage disposal.

A. That I do not know, but I do know that they are all that are required at the present time.

Q. Are there any details of the method of sewage disposal set forth in these reports that you have quoted from?

A. Only in so far as I have already read into the testimony.

Q. Have you made any estimate of the percentage of the cost that this tunnel would amount to that would transport sewage from the sewage disposal works at or near the Newark meadows to the outfall at Robbins Reef?

Mr. Riker: The question is objected to as immaterial and irrelevant, and as impertinent to the issue.

The Commissioner: Note the objection of counsel for the defendant.

A. Features of construction were outside the part in which I was interested in connection with the study of this problem.

Q. Do you find such a computation in the Hazen and Whipple report submitted to the city of Paterson?

A. They made such a computation I believe.

Q. Amounting approximately to what percentage of the entire cost?

Mr. Riker: I enter the same objection.

The Commissioner: Note the objection of counsel for the defendant.

A. I could not say.

Q. In that report was the degree of treatment recommended for the city of Paterson to adopt of a higher or lower grade than that adopted by the Passaic Valley Sewerage Commissioners for the 1837 treatment of the sewage to be discharged at Robbins Reef?

A. It is more complete and necessarily so because of the conditions under which it would have to be discharged.

Further redirect examination by Mr. Riker:

Q. Do you think that the substitution of a finer mesh for the 4/10 screen, would be a *laeuf* additional requisite?

Dr. O'Sullivan: I object to the question on the same ground as which Mr. Riker previously objected; that it calls for a judicial determination of a matter not within the purview or knowledge of this expert.

The Commissioner: Note the objection of counsel for the complainant.

A. I do not anticipate that such will be necessary for many years

to come in any event, still I believe it is perfectly within legal reason to substitute a screen of finer mesh if deemed necessary in the future.

Q. Do you know of any thing unlawful in such a substitution?

A. No sir.

Q. Do you think that additional sedimentation will be an additional lawful arrangement to that prescribed in the stipulation?

Dr. O'Sullivan: Note the objection of counsel for the complainant.

The Commissioner: Note the objection of counsel for the complainant.

A. No sir.

3838 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,

vs.

THE STATE OF NEW JERSEY and THE PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

Name.	Direct.	Cross.	Redirect.
Charles A. Van Kuren.....	4127	4128	
Thomas H. McCann	4132	4133	
John Payne	(4139)	4144	4156
John S. Gibson	4142(	4162	
John S. Gibson	4158		

This volume contains the testimony taken during the latter part of the day on February 20th, and that taken on February 21st, and completes defendants' testimony on the main case.

3839 CHARLES A. VAN KUREN, a witness produced on behalf of the defendants, being duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. Riker:

Q. Where do you live?

A. Jersey City.

Q. What is your official position, if you hold one?

A. Chief Engineer of Jersey City.

Q. How long have you been such?

A. I have been their Chief Engineer for 15 years; prior to that I was assistant for 15 years.

Q. Have you or have you not had charge of the construction of the sewers of Jersey City?

A. I have.

Q. Are you familiar with the outfalls into New York Bay or the Hudson River?

A. I am.

Q. In making these sewers was the work under your charge as Engineer?

A. Yes, sir.

Q. In making such outfalls did you ever in any way or did anyone to your knowledge on behalf of your municipality apply to the State of New York, or to the City of New York for any permit or recognition of the rights you were exercising?

A. No, sir, not to my knowledge.

Q. In a general way the sewers of Jersey City are of the combined system, are they not?

A. Combined system.

Q. Have you ever heard of any claim on the part of the State of New York of any jurisdiction over the construction of outfall sewers into the Upper New York Bay?

3840 Dr. O'Sullivan: The question is objected to on the ground that this matter is not at all in issue or pertinent to the issue.

The Commissioner: Note the objection of counsel for the complainant.

A. I have not.

Cross-examination by Dr. O'Sullivan:

Q. How many trunk sewers empty or have their outfalls into New York Bay from Jersey City?

A. About, I should say, a dozen main sewers.

Q. What is the daily volume of sewage discharged from these main or trunk sewers?

A. About 46,000,000 gallons.

Q. What is the daily volume of trade wastes discharged by Jersey City into New York Upper Bay?

A. I never looked into that, I am not prepared to say.

Q. What is the character of the trade or factory wastes discharged into New York Upper Bay from the main or trunk sewers of Jersey City?

A. Generally manufacturing.

Q. Will you name some of these manufacturing plants whose trade wastes go into New York Upper Bay from Jersey City?

A. There are all kinds of manufactures there, there are iron foundries and like things, wooden ware construction and general trade of all description.

Q. Have you woolen mills?

A. No; silk mills.

Q. Have you got silk mills?

A. One silk mill.

Q. Have you any soap works in Jersey City that discharge their trade waste into New York Upper Bay?

3841 A. There is one, Colgates; what they discharge I am not prepared to state.

Q. How do you estimate the volume of sewage that is daily discharged into Upper New York Bay from the main or trunk sewer outfall of Jersey City?

A. I estimate the consumption of water.

Q. How much water does Colgates' soap factory use per day?

A. I cannot state that offhand.

Q. How much of that water does it get from the public water supply?

A. That is not in my department and therefore I would not be familiar with it; that is in the metre department, they take all these metre measurements; I am not familiar with that; but I can state that the railroads use one-quarter of the consumption.

Q. For what purposes?

A. For steam purposes and domestic as well, at their depots.

Q. They get their water supply from the public water supply?

A. Yes sir.

Q. And it is metered, is it?

A. Yes sir.

Q. Do you know if Colgates get any of their water from the public water supply?

A. I believe they do, I am not prepared to state; I should judge they did; they may have a well there.

Q. And whatever the volume of their trade wastes is would be estimated by you on the metre supply of the public water supply?

A. I did not say so; I did not know the conditions, I am not familiar with the condition there and therefore could not say sir.

Q. What I am trying to get at is how you estimate 46,000,000 gallons of sewage per day—

3842 A. I say that is our consumption of water, 46,000,000 gallons.

Q. 46,000,000?

A. Yes sir 46,000,000 I said.

Q. Is that the entire water consumption?

A. Yes sir.

Q. Do you regard the sewage discharge as equal to the water consumption and not exceeding it?

A. No, I say it exceeds it.

Q. By how much?

A. I cannot tell you that; I do not know how many wells they have and I have never entered into this matter to determine it.

Q. Do you know if any of those manufacturing plants use ground water for the purpose of their manufactures or whether they get water from wells?

A. There are some of them who use wells, driven wells.

Q. Will you name some of them?

A. I can name one and that is Lembeck & Betz, brewery.

Q. How much water do they use?

A. I don't know.

Q. Is brewery waste particularly objectionable as a trade or factory waste?

A. Not that I know of.

Q. Do you know anything about it?

A. Not about that, I am not prepared to state that; I am not engaged in the chemist business.

Q. Do you make a distinction between trade and factory wastes?

Mr. Riker: The question is objected to on the ground that it is not cross examination; Mr. Van Kuren has testified as an engineer to the construction of sewers, and nothing else.

3843 The Commissioner: Note the objection of Counsel for defendants.

A. I came here for that purpose and I am not prepared to state anything other than that.

Q. Have you made any special study of sewage or sewage disposal at all?

A. No sir, I have not arrived at that.

Q. Have you made any special study of bacteriology in connection with sewage disposal?

A. No sir.

Q. No biological examination?

A. No sir.

Q. Nor of chemistry?

A. No sir, I have not.

Q. And your estimate of the volume of sewage discharge is based on the supply of Jersey City?

A. And the water that they receive from wells.

Q. Have you made any estimates of that?

A. No sir, other than the consumption as I say, the consumption of 46,000,000 average; about $3/5$ of that would enter the Hudson River.

Q. And that is how you make computation of its volume?

Mr. Riker: He has not said so.

A. As far as it goes, not beyond that, I have not gone into that matter; I so stated and therefore I am not competent to answer your question.

Q. Do you know whether or not your sewers are now running at their maximum capacity?

A. The maximum capacity? They are the combined system.

Q. Are they running at their maximum capacity?

3844 A. During a storm they will, if the magnitude of the storm is sufficient.

Q. What is the combined capacity of the 12 trunk outfall sewers you have described?

A. It will take a few figures to give you that, I am not—I have got to get my maps and the size of my sewers and make that calculation, but we calculate on taking care of certain rainfalls and the sewers are constructed of sufficient size.

Q. Are you sure whether or not the sewers at their outfalls discharge 90,000,000 gallons of sewage per day in New York Bay?

A. I am not sure, no sir.

THOMAS H. McCAN, a witness produced on the part of defendants, being duly sworn by the Commissioner, testified as follows.

Direct examination by Mr. Riker:

Q. Where do you live?

A. Hoboken.

Q. What is your business or profession?

A. Civil Engineer.

Q. How long have you been engaged in that profession?

A. About 43 years.

Q. Have you had anything to do with the construction of outfall sewers from Hoboken and the territory on New York Bay North of Hoboken?

A. Yes sir.

Q. What connection have you had with that?

A. In the matter of designing and constructing practically all of the outlets North of the Jersey City line.

Q. Have you ever in that connection made any application to the State of New York or to the City of New York for any permit to discharge sewage into New York Bay?

3845 A. Oh, no, I never heard of such a thing.

Q. Have you ever heard of New York, either state or city, asserting any right to control the discharge of sewage into New York Bay on the New Jersey side?

A. No sir, I never met with any obstacles from anybody.

Cross-examination by Dr. O'Sullivan:

Q. How many trunk outfall sewers discharged into New York Upper Bay from Hoboken?

A. I will have to consult my notes, I can give it to you.

Q. Can you give me approximately the number?

A. Nine. I will make sure if you will let me look at my notes.

Q. Yes.

A. (After referring.) Yes, nine.

Q. What is their maximum capacity, those nine trunk outfall sewers?

A. Well, if you mean—tell me what you mean by the capacity, sir; I could not tell you what the sewers all actually discharge but I can tell you what they are provided for.

Q. What are they provided for?

Mr. Riker: The question is objected to as not cross examination?

The Commissioner: Note the objection of counsel for the defendants.

A. One way of answering your question is to say that these outlets are all on the combined system, that is they don't take sewage alone, they take sewage with running water and the amount of water is the index to determine the capacity; they are all generally based on discharge of an inch of rainfall per acre per hour.

3846 Q. What trade wastes do your trunk sewer accommodate in Hoboken, going into the New York Upper Bay?

A. Practically all of whatever factories are there.

Q. What factories are there?

A. There are many factories of various kinds.

Q. Are their abbatoirs?

A. Sir?

Q. Are there slaughter houses?

A. No, I don't think there's a slaughter house North of—in fact I can swear there is not a slaughter house North of the Jersey City line and I think there are only one or two in Jersey City.

Q. Are there any woolen mills?

A. Woolen mills? Well there can't be very many.

Q. How many?

A. Well, there probably would not be—I cannot recollect a single one.

Q. What factories do you recollect that discharge their trade wastes through the Hoboken trunk sewers?

A. Hoboken? Well we have pencil factories, pocket-book factories and there is a large factory making surveyor's instruments, and so on, and there are toy factories and a great many factories, but they are generally small in Hoboken.

Q. Have you any machine shops?

A. Yes sir.

Q. What is the character of their trade wastes?

A. The trade wastes of a machine shop?

Q. Yes.

A. You mean from a sanitary point of view?

Q. From any point of view.

3847 A. I would not be prepared to answer that now, I would have to have some thought over that but I cannot fancy that it is very detrimental to health.

Q. Are there any acid trade wastes discharged from these machine shops?

A. Well, as far as Hoboken is concerned I don't think there are many machine shops in the city and they are very small affairs and it cannot amount to much if they do.

Q. What acids do they use in the machine shops?

A. I do not know, I am not an expert on that.

Q. Have you had any complaints against the outfalls of these trunk sewers in Hoboken?

Mr. Riker: The question is objected to on the ground that it is not cross examination and it is immaterial to this issue.

The Commissioner: Note the objection of counsel for the defendants.

A. Where the sewer empties at the physical bulkhead—you know there are two bulkheads, the physical and the legal line, and in cases where the sewers—and I think there is only one—empty at the physical bulkhead, at certain stages of extreme low tides there have been complaints.

Q. From whom?

A. From people in the neighborhood, but where we have got

the sewers extended to the pier line out into the current of the river, we have a very strong current in the Hudson River, especially on the Jersey City side, we have very deep water, 60 feet deep.

Q. Have any of the big steamship companies complained against your trunk sewer outfalls?

3848 A. No, because the North German Lloyd is the only steamship Company that is affected by the outlet and they have carried that outlet under their own piers at their own expense.

Q. How about the Hamburg-American line?

A. There is no sewers empty at the Hamburg-American line—oh yes, I beg your pardon, at the foot of Newark Street they have a paise in point; that should be carried out to the pier line and there would be no complaint.

Q. Have they not frequently complained of the offensive odor and the injury to the paint on their structures?

A. Yes sir, at those outlets, that is the only occasion.

Q. Can you give me any estimate of the volume of trade wastes and sewer discharged from these sewers in Hoboken into the Upper New York Bay?

A. No, I cannot differentiate the trade wastes and sewage from the combined flow of the sewer.

Q. I ask you to take the entire flow of the sewage, by whatever name you call it, and of whatever character it is that is discharged by these trunk sewers into New York Bay?

A. I answered that before, that it is equivalent to—at the maximum amount it is equivalent to an inch of rain per acre per hour.

Q. To what?

A. It is equivalent to the drainage of an inch per acre per hour, of the drainage area.

Q. How many acres do you count on in making that estimate?

A. East outfall has its own drainage area and those drainage areas vary.

Q. Taking that basis of computation, how much do you estimate the discharge from these trunk sewers into New York Upper Bay is?

A. Estimate what, the quantity of water?

3949 Q. The quantity of material that goes out through those trunk sewers.

A. All right—now if you take the Third street sewer of Hoboken, the drainage area of that sewer is not quite 800 acres; it drains one-half of that area so there are 800 cubic feet per second flowing from that sewer when it is doing its maximum work.

Q. And that is in addition to the regular sewage flow, is it not?

A. I do not get that.

Q. Is the item that you have just testified to in addition to the regular sewage flow?

A. Oh, the sewage flow, that is insignificant; it is the great bulk of rain-water that we have to provide for.

Q. What do you estimate the dry weather sewage flow accommodated by these Hoboken sewers and discharged into New York Upper Bay, to be?

A. The most conservative answer to that is that it will equal the water supply of the city. There is so much water going in and there must be so much water going out, that is the rough way to get at it. Now you want to know what that is, I suppose?

Q. Can you give it?

A. It is about 100 gallons per capita of the city.

Q. What is the population of the city?

A. Now it is somewhere about 70,000 I think.

Q. And there is no other water used by these factories or otherwise excepting the water that comes from the public water supply?

A. No. That is a maximum too, conservatively it should be taken at about 75 gallons per head.

Q. Do any of these factories get water from ground water or artesian wells?

A. Well, there are one or two. Hoboken is a poor place for wells.

3850 Q. How about ground water?

A. The leakage of ground water won't amount to much in Hoboken because our soil is quite porous.

Q. Have you installed your new sewerage system yet in Hoboken?

A. Council has adopted a new system, that is, they have adopted a system, they have never had a system before and now we have got one.

Q. Are many of these trunk outfall sewers little more than septic tanks now?

A. Oh they are not septic tanks, not the outfalls, the outfalls are—we find them clean, they flow good; some of them have been improperly constructed in former times and these sometimes become stagnant.

Q. Don't they clog up some distance back from the outfalls themselves?

A. There are some of them that are not on a proper grade; of course to answer that question you would have to have a map here, showing every street and every sewer.

Q. On several are not the grades reversed?

A. Sometimes.

Q. You have had numerous complaints about the odors from these sewers have you not?

A. In the outer district it is in Hoboken the same as in any other city, where they don't have proper outfalls, they will complain.

Q. Who else has complained of injury to their property besides the Hamburg-American line, arising from the offensive odors and discharges from the trunk sewers of Hoboken?

A. Nobody that I know of. There were some complaints from the Delaware & Lackawanna Railroad but that is outside of
3851 the city line, if you know where Ferry street is, there are three or four sewers running from that into the old canal; the city has acquired rights to it; that canal is a shallow basin, a long shallow basin and it became on account of sewage going into it foul, and that has been rectified now.

Q. Who else beside the Lackawanna Railroad.

A. That was not a complaint, the city had a right to go there, the railroad company had to put up with it.

Q. They had to stand it?

A. Until it was rectified.

Q. Who was the consulting engineer employed by the City of Hoboken to advise them on the installation of a new sewage system to displace this defective sewage system you have testified to?

A. Mr. James—I have forgotten his middle name—Fuentes.

Q. Mr. James H. Fuentes?

A. Yes sir.

Q. Have you read his testimony in this case?

A. No sir, I did not know he testified.

Q. Did you graduate as a civil engineer?

A. From Cooper Institute night school.

Q. How long have you been in Hoboken?

A. Since about 1870.

3852 JOHN PAYNE a witness produced on behalf of the defendant having been sworn by the Commissioner testified as follows:

Direct examination by Mr. Riker:

Q. Where do you live?

A. Jersey City.

Q. What official position do you hold?

A. I am secretary and Engineer of the State Board of Riparian Commissioners of New Jersey.

Q. How long have you held that position?

A. About seventeen years; thirty five years, as Assistant Engineer and about seventeen years as Secretary and Engineer, the latter seventeen years.

Q. Are you familiar with the methods of procedure of that commission?

A. Yes sir.

Q. What do they do with reference to filing lines of solid pier filling and lines for pier heads in New York Bay on the New Jersey side?

A. They have fixed such lines after making surveys of the waters and have changed the lines at different times, since 1865 when the first line was fixed.

Q. In that connection do they apply for any permit or authority or approval of the State of New York or any municipal body in the State of New York.

A. No sir.

Q. Do they apply for the authority of any body with reference to that matter?

A. No sir.

Q. Have they from time to time fixed lines of—

A. I beg your pardon; in the case of fixing lines around the reefs and shoals, under an act of the Legislature, in New York Bay

under an act of the Legislature, it is first necessary to apply
3853 to the Secretary of War for approval of the lines suggested.

Q. Do you know whether the Riparian Commissioners and the Governor have made any grant to the United States of land under water in New York Bay.

A. Yes sir.

Q. Where?

A. On February 14, 1880 the State of New Jersey made a grant to the United States Government of ten acres surrounding Robbins Reef Light in New York Bay; on November 30, 1904, the State of New Jersey made a grant to the United States Government of land surrounding Ellis Island.

Q. Have the Commissioners fixed lines of solid filling in New York Bay on the New Jersey side?

A. Yes sir.

Q. Have filling been made out to that line so fixed?

A. Yes sir.

Q. Where, in what instances?

A. Nearly the entire front from Fort Lee, and indeed above Fort Lee but nearly the entire Hudson River front from Fort Lee to Constable's hook has been granted by the State of New Jersey and a great part of it has been filled to the solid filling line and piers built to the pier head line and occupied by the various steamship lines and commercial enterprises doing business on that shore.

Q. Has any permit or approval on the part of the State of New York for any of those actions been given?

A. No sir.

Q. Has there been any remonstrance by the State of New York, or by any municipal bodies in New York, so far as you know, to this course?

A. No sir.

3854 Q. Have you a map with you, showing the lines dividing the State of New Jersey from the State of New Jersey?

A. Yes sir I have one of the copies of the map filed with the report of the Commissioners of 1887 showing the boundary line in New York Bay, the Kill Von Kull and a part of Newark Bay.

Q. Will you look at this map and tell me what line on that map indicates the dividing line between the State of New York and the State of New Jersey and described it, either as a dotted line or a solid black line, or whatever description you think will identify it.

A. The line dividing the State of New Jersey from the State of New York in New York Bay begins at a point mid-way between the Central Railroad Terminal at Jersey City, and the Battery at the lower end of New York Island, and is marked on this map K. or A.A. at a point enclosed by a triangle. The line is shown as a full black line running southwest to a point between the Bay Ridge and Staten Island and about southwest from Robbin's Reef Light and is marked by the letter J. Prime, and is a point enclosed by a triangle; the line then runs in a pretty nearly westerly direction and is indicated by a full black line to a point between Constable's

Hook and Brighton, Constable's Hook in Bayonne and Brighton in Staten Island, and is indicated by the letter L. prime and is a point enclosed by a triangle; that is the mouth, from the New York end, of the Kill Von Kull.

Mr. Riker: I offer this map in evidence.

The Commissioner: That will be marked defendant's exhibit 4.

Dr. O'Sullivan: I should like to examine the witness about the map before it is marked.

Dr. O'Sullivan:

Q. Who prepared this map?

A. The Commissioners indicated on the map: M. W. 3855 Hazeltine, Robert Moore, G. C. Hannis, New York Commissioners, R. C. Bacot, William Olliver and E. A. Stevens, New Jersey Commissioners; and it is marked "Map showing line agreed upon filed in the office of the Secretary of State of New York," and under the New Jersey Commissioners "Map showing line agreed upon filed in the office of the Secretary of State of New Jersey."

Q. When was that boundary line adjusted?

A. As indicated on the map and written "Agreed upon by the Commissioners appointed by the Governors of their respective States, on December 23, 1889."

Q. Was that boundary line ratified, by the Federal Government in any way?

A. I do not recall that it was, sir, although my impression is that the maps were filed at Washington.

Q. Does that differ from the boundary line that existed in 1833?

A. No sir, it is the definition of the boundary line fixed by the Treaty in 1833.

Q. And is identical with it as far as you know?

A. Yes sir.

Q. Have you compared the copy of the map that you have produced here with the original.

A. Yes sir.

Q. And find it how?

A. An exact copy.

Dr. O'Sullivan: I make objection to the map on the general ground that it is irrelevant.

The Commissioner: Note the objection of counsel for the complainant.

(Map marked Defendant's exhibit 4.)

Further direct examination:

Q. In connection with your duties as Secretary and Engineer for the Riparian Commissioners have you familiarized yourself in any way with the shipping and shipping interests along the New Jersey Shore on Upper New York Bay?

A. Yes sir our commission is generally familiar with the fact of the existence of the interests, without going into the extent of details of their business.

Q. Are there trans-Atlantic steam ship lines that dock on the New Jersey Shore?

A. Yes sir a number dock at Hoboken; the principal ones are the Hamburg-American, the North German Lloyd, the Scandinavian Line, I think, and the Holland-American Line, and two or three other lines the names of which do not occur to me at this time, and at Jersey City there is now an Italian Line, docking at the Pennsylvania Piers.

Q. Along this shore are there or are there not a number of important Railroad Terminals?

A. Yes sir, the New York, Susquehanna and Western have their terminal on the Hudson River, at Edgewater, about opposite Grant's Tomb; the New York Ontario and Western have a terminal; the West Shore Railroad have their extensive terminals on the shore at Weehauken; the Delaware and Hudson Canal Company have, or had their coal terminal; the Delaware, Lack-wanna and Western Railroad have their terminals below Hoboken; the Pennsylvania Railroad has the property which was used until recently as their terminal, and the Lehigh Valley have their Railroad has its terminal at Jersey City; the Central Railroad of New Jersey has its entire terminal at Communipaw; the New Jersey Junction Railroad has its Warehouses and terminals below Jersey City; the Pennsylvania Railroad has its freight terminals at Greenville, in Jersey City on New York Bay.

Q. Are there important manufacturing interests or factories located along the shores of New York Bay on the New Jersey side that you know of?

A. Yes, there are at least two important sugar refineries, one is the Knickerbocker Refining Company and the name of the other I do not recall. Pyles Pearlline Company have an extensive factory; the chemical interests have two or three important factories; the lumber interests have distributing depots at Hoboken and at Jersey City.

Q. Is Colgate's Soap factory there?

A. Colgate's Soap factories are back from the River a short distance, but distribute by loaded cars, directly onto the boats at the River front.

Q. Is there any considerable interstate commerce by water carried on from the New Jersey shore?

A. Yes sir.

Cross-examination by Dr. O'Sullivan:

Q. When you want to extend your pier head line to whom do you apply for permission?

A. The State extends its pier head line of its own volition or desire, but it is necessary before that is operated, under the Government, for the Government, to approve that line, and the commission applies to the Secretary of War for conference in the adoption of any line that they desire to establish.

Q. By "Government", when you use that term, what do you mean, what Government?

A. The United States Government?

Q. Can you extend your pier head line indefinitely without permission from the Federal Government.

A. The state could, but it would not be operative, or would not be permitted, possibly, by the United States Government, until the Secretary of War had approved that extension.

3858 Q. Have you not got applications now before the Secretary of War for the extension of piers and desiring his permission before you undertake the work of extending those piers?

A. No sir, not now. The Government had—the Secretary of War—the commission had an application before the Secretary of War and that application was not concurred in but recently, on February 5th, the Secretary of War fixed a line that he did approve, and last Monday the Governor and Commissioner adopted that line approved by the Secretary of War, February 5, 1913.

Q. Would your State be permitted to extend these lines despite his denial permission.

A. Yes sir, our State would have the power to extend the line but it would not have the power to enforce a construction out of that line, I think, in opposition to the dicta of the Secretary of War.

Q. Is not his dicta final in relation to navigable water no matter whether within a State or interstate.

A. Yes sir, the State of New Jersey so regards it.

Q. That would hold good on the Passaic River which is entirely within New Jersey territory?

A. Yes sir.

Q. Relating to that boundary line, and the compact between the states in 1833 do you know if any other matter relating to the states' jurisdiction over Upper New York Bay was settled in that contract, other than the boundary line?

A. I do not recall; my impression is, however, that the duties of the Commission appointed, and who made that map, were simply to settle definitely and geographically the location of the line and not other questions.

Q. What year are you talking about now?

3859 A. 1889, the date of the actual defining of the line referred to in the Treaty of 1833.

Q. My question related to the treaty or compact of 1833, whether any other matters relating to interstate or state jurisdiction were settled in that compact other than the boundary line.

Mr. Riker: The question is objected to on the ground that Mr. Payne has not attempted to qualify as an expert in law, and that the interpretation of the compact between the States, does not depend upon any expert witness or other witnesses, that the question of procedure under it and facts of the procedure may be relevant but the opinion of a witness on the legal effect of the compact is not competent.

The Commissioner: Note the objection of the counsel for the Defendants.

Dr. O'Sullivan: The question is pressed by counsel for Complainant on the ground that the map produced here and offered in evidence is merely a registering of a line which was determined in 1833, and was only part of a compact, or of the work done by the commission in 1833, and for the purpose of testing this witness's memory, as to what other portions of that compact were, and how they related to this boundary line and kindred matters.

A. I am not competent to answer that question.

Q. As a matter of memory do you know whether or not there were other matters in the compact defined besides the boundary line.

Mr. Riker: The question is objected to as not being a proper subject to test the memory of any witness.

The Commissioner: Note the objection of counsel for the defendants.

A. I am speaking from my impression, from my—my impression of my recollection, perhaps, that there were questions of jurisdiction, perhaps, or other questions, than those relating to the location of the line, but I may be speaking only from a recollection, not derived from the treaty at all, but from subsequent reading or discussion.

Q. How was that boundary line determined in 1823?

A. I cannot give the description, sir, definitely, from recollection, but it was a general boundary line, and the nature of the description, gave rise to differences of opinion, and the definite fixing of the line in 1889 was to clear up these differences of opinion.

Q. How was the line fixed in 1889, the boundary line between the states?

A. I cannot say that I understand your question, do you mean that method was used?

Q. How was it determined, how was its exact location determined?

Mr. Riker: If you know?

A. I only know by some slight connection, some little work with the work of the commissioners, I had some work in it; they took the map, for instances, showing—they took the Government map showing the high water line of 1833 and from that located a line as a boundary line that in the judgment of the commissioners followed the description in the treaty of 1833.

Q. Were you connected with this commission that you represent here now, in 1889.

A. Yes sir.

Mr. Riker: I think the form of that question if objectionable; he does not represent the commission here, now.

Witness: I beg your pardon, do you mean the Riparian commission?

Mr. Riker: He does not represent the commission; he is
3861 here as an individual who happens to be the secretary of
the commission; the commission is not here officially.

Q. Are you appearing here as a witness, as Secretary of the
Riparian Commission, or simply *or* in a private capacity as Mr.
Payne?

A. In a private capacity, as Mr. Payne, sir.

Q. And you disclose knowledge which came to you through be-
ing Secretary of the Riparian Commission, is that right?

A. I have given information, yes sir, that I have gained as
Secretary of the commission.

Q. And the map you produced here, how did that come into your
possession?

A. That is one of a great number of copies of the boundary
line map that were distributed gratuitously, by the State authorities,
and I, in common with any other citizen that desire it may have
copies of them, and I have some copies of that map.

Q. And the copy you produce here you procured in your capac-
ity as a private citizen?

A. Yes sir.

Q. And then as Secretary of the Riparian Commission you com-
pared the map which you got as a private citizen, with the orig-
inal map which was in your custody as Secretary of the Riparian
Commission. Is that right?

A. I had previously compared one of these maps with the orig-
inal map and knew that it was an exact copy.

Q. Did you compare this particular copy of the map offered
here today?

A. I compared this map that is offered to-day with the copy I
had compared previously with the original map, and it is the
same.

Q. In whose possession was the copy that had been com-
3862 pared with the original?

A. That is in the possession of the Riparian Commission.

Q. Have you access to their maps?

A. I have the custody of their maps.

Q. So that you could have compared it with the original as well
as with the compared copy.

A. Yes, but the original is in a tin case, and a little difficult
to get at, so I saved myself the trouble of taking it out or getting
it out, and reached the result I have stated.

Q. Where was the original prepared, in the State of New Jersey
or in the State of New York.

A. It was prepared in the State of New Jersey.

Q. And in fixing the lines what metes and bounds or other mat-
ters were taken to define the boundary line?

A. A very elaborate system of metes and bounds was used and
are set forth in the report of the commissioners to the Legisla-
tures of the two states, and filed in the Secretary of States' offices
and also published in the report of the Riparian commission of
New Jersey in 1891, giving the location of each of the angle

points that I have merely referred to by letter, on the map, under discussion.

Q. So that Mr. Payne, this map which you have produced here has rendered and defined the boundary line as determined in 1833.

A. Yes sir.

Q. Do you know whether it follows the *filum aquæ*?

A. Yes sir, that was one of the points that the New Jersey commission and Mr. Robert T. Bacot, the engineer of the Riparian Commission then and a member of the boundary commission prides himself on as having secured that for the state of New Jersey.

Q. So that if the Channel should change its course, the
3863 boundary line would follow the changed channel line.

A. I cannot say as to that.

Q. Your connection dates from when, what year, with the Riparian commission?

A. 1877.

Q. Since 1877 had New Jersey at any time to your knowledge exercised police or quarantine jurisdiction over New York Upper Bay?

A. I cannot say as to that, I am not familiar with that subject.

Q. Are those matters which in any way interest the Riparian commission.

A. I presume, sir, you mean interest them officially?

Q. Yes.

A. I do not think so, excepting that I think if an application were made and it was disclosed that the property was to be used for a purpose detrimental to the interest of the community and State, the Government and the Commission would take cognizance of it in the consideration of the application.

Q. What is the objective of quarantine jurisdiction?

Mr. Riker: If you are an expert and know.

A. I am not competent to speak understandingly of the subject.

Q. Does it relate to property Riparian Rights or to health?

Mr. Riker: If you know.

A. I should say generally it refers to health.

Q. You mentioned something about the sugar interests.

Mr. Riker: The what?

Q. The sugar factories; do you know anything at all about such trade wastes.

Mr. Riker: The question is objected to on the ground
3864 that the witness has said nothing whatever about trade wastes or sugar wastes, and that the question involves a mis-statement of his testimony.

The Commissioner: Note the objection of counsel for the defendant.

A. If I may say, I do not recall mentioning anything about the

process of manufacture of sugar but merely intended to speak of the location of the sugar industries on the shore.

Q. Are you a Civil Engineer?

A. No sir, I acquired my knowledge by practice.

Q. Do the Riparian Commission take under their observation and notice trunk sewer outfalls along the Ripa?

A. They do now, sir, and where there is an application, for such sewer outlets the matter is referred to the State Board of Health, for advise and suggestion.

Q. How many trunk sewer outfalls discharge into upper New York Bay from Jersey City, Weehawken, Hoboken, and Bayonne?

A. I could not tell you, I have no knowledge on that subject.

Q. Can you give me any approximate number.

Mr. Riker: The question is objected to on the ground that it has already been answered, and on the further ground that the witness was not examined on the direct examination, on any subject connected with sewer outfalls.

The Commissioner: Note the objection of counsel for the defendants.

A. I could not give you any answer that would not be a mere guess, and which would be valueless as information.

Q. Do the Cities that I have named, Mr. Payne have to get permission from the Riparian Commission before building and
3865 operating a trunk sewer that is discharging at the pier head line or the bulk head line.

A. They do, sir, if they have not either themselves, under their own authority acquired the Riparian rights or gotten permission from those who have acquired the Riparian rights, and that is only as to the occupation of the land for some structure, not so much as to the use of the structure.

Q. In giving permits of that kind, is it necessary to know whether or not in that immediate neighborhood there are a large number of like structures?

A. As to that I think my previous answer, that the commission refers such matters to the State Board of Health for advise and suggestion, covers the present question.

Q. Does your commission design, or pass upon the design, of the piers used by the big Liners that you have mentioned.

A. No sir, the State has no authority over the plan of construction, excepting that in the grant it is stipulated that between the bulk head line and the pier head line, piers alone shall be built.

Q. If those piers are to be extended out, they apply to your commission for a permit.

A. May I ask—extended?

Q. Toward the main ship channel.

A. Beyond the existing pier head line?

Q. Yes.

A. That would not be the procedure; they would apply for the extension of the pier head line, and then, if their conveyance was of that character, their rights would go out automatically, but

that would depend on the character of their conveyance, *their* being three different kinds of State grants in use, since 1869, when the State began to make State grants through its Riparian Commission.

3866 Q. For instance, if the Hamburg-American line wished to extend its present piers, to whom would it apply for a permit for the extension, I mean in the direction of the main ship channel?

Mr. Riker: The question is objected to on the ground that it is not definite as to what extension is referred to, whether it is beyond the present existing line, or the pier head line fixed by the State Board.

The Commissioner: Note the objection of counsel for the defendants.

A. May I ask that you will define to what line, you refer in your question of extension?

Q. To any line that bounds the present pier, the extending of their present line, to whom would they apply for permission to make the extension, that extension being in the direction of the main ship channel?

A. That is a question that I am not competent to answer, because in the discussion that came up before the Governor and the Riparian commission last Monday on the application of the Hamburg-American line for the adoption by the State Riparian Commission of the line fixed or approved by the Secretary of War on February 5, 1913, the question of the rights of the Riparian grantee were not passed upon, but were left in obeyance, and I am not competent to answer the question.

Q. Who presented those requests for extension to the Secretary of War, was it your commission?

A. I am not sure that I understand your question, sir the request for what?

Dr. O'Sullivan: Strike out the question.

3867 Q. Mr. Payne, you have just described in your testimony requests for pier extensions that have been passed upon by the Secretary of War; I ask you who submitted the requests for those permissions to the Secretary of War, whether it was your commission, or whether it was some other commission.

Mr. Riker: The question is objected to on the ground that it involves a statement of fact something that has not yet appeared on record, that there was any application by the commission to the Secretary of War.

The Commissioner: Note the objection of counsel for defendants.

A. That question is not clear to me, and it seems to involve two transactions, I do not wish to be captious, but the requests for the adoption by the Riparian Commission of the extension of the pier head line approved by the Secretary of War, February 5, 1913, was a request for the adoption of the line in its entirety, and not for the

extension of any piers, but was made by the Hamburg-American line and was for the adoption by the State of the line approved by the Secretary of War.

Q. Does your commission, the Riparian Commission, pass upon these applications in the first instances.

Mr. Riker: The question is objected to on the ground that it is indefinite, it does not appear what applications are referred to.

The Commissioner: Note the objection of counsel for the defendants.

A. May I ask you, sir, to define what applications you refer to?

Q. What applications did the Secretary of War pass upon, in February or in any other month of this year so far?

Mr. Riker: If you know.

A. They were the applications of the steam ship interests 3868 and—I am speaking from general knowledge as well as some particular knowledge—of the general, commercial and maritime interests of the Port of New York and were supported by the municipalities of the two states and were also supported by the application of the State of New Jersey through its Riparian Commission to this extent, that if any extension of the line on the New York side of the Hudson River was allowed by the Secretary of War, a similar extension of the line should be allowed to the State of New Jersey on the New Jersey side of the Hudson River, and this course has been adopted by the Secretary of War in his approval of the line of February 5, 1913.

Q. Through what commissions were these applications transmitted to the Secretary of War?

A. As far as the Riparian Commission is concerned, the application or request was transmitted directly to the Secretary of War, as my general knowledge is that all applications are, it is a matter of practice that they must go to the Secretary of War first and then are referred by him to his Advisory Board, the New York Harbor Line Board.

Q. Do you know whether or not there is a joint commission from the States of New York and New Jersey, known as The Commission for pier extension and Harbor improvements in the Harbor, meaning the Harbor of New York.

A. Yes sir, I believe there is such a commission.

Q. Does the Riparian Commission co-operate with that joint commission, or is it practically entirely separate and distinct?

A. I do not know of any other way that the Riparian Commission has co-operated with that commission except in furnishing any information as to existing locations or lines or in any other way that the New Jersey Commissioners have requested them to make.

Q. The information at the disposal of the Riparian commission has, at all times, has it not, been at the disposal of the joint 3869 commission, that is the end of the joint commission relating to the State of New Jersey?

A. Yes sir.

Q. Mr. Payne, how near to the boundary line, that you have described on the map that has been marked in evidence are the trunk outfall sewers of Bayonne, Jersey City, Hoboken and Weehawken?

A. Those distances vary greatly, because I have described only the boundary line in New York Bay, and the outlet of the sewers in Weehawken would be miles and miles up the river from the line I described. I do not mean to be captious, but you can see the point.

Q. Do those trunk outfall sewers discharge at high or low water marks?

A. I am not competent to answer that, so that if would be of any real information.

Q. How near the boundary line is the trunk outfall of this Passaic Valley Trunk Sewer project?

A. I do not know the location of the outlet of the trunk sewer and it is not marked on the map.

Redirect examination by Mr. Riker:

Q. You were asked about a joint commission on pier and harbor lines, I think it was called.

Dr. O'Sullivan: Pier extensions and Harbor Improvements.

Q. Pier extensions and Harbor improvements, do you refer in your testimony of the New Jersey Harbor Commission?

A. Yes sir.

Q. That is the commission you referred to?

A. Yes sir.

3870 Q. That is the commission you referred to, the New Jersey Harbor Commission, is it not?

A. In connection with the New York Commissioner, as the joint joint commission.

Q. Do you know as a matter of fact whether there is any joint commission?

A. Yes sir.

Q. You think then, that this commission is simply to act jointly with a similar body of New York, and a Federal Commissioner in the investigation of the Ports of this country and abroad.

Dr. O'Sullivan: The question is objected to as clearly a cross examination by counsel of his own witness.

Mr. Riker: Of matters you brought up yourself.

Commissioner: Note the objection of counsel for complainant.

A. I understand that is the promise of the commission.

By Dr. O'Sullivan:

Q. Which commission did your answer contemplate?

A. The joint commission, that on the part of New Jersey, and three commissioners on the part of New York together with a Federal Officer to complete the commission.

At this point the further taking of testimony on the part of the defendants was adjourned until Friday the 21 day of February, nineteen hundred and thirteen at 10:30 A. M. at the office of Messrs. Riker & Riker, Newark, N. J.

3871 Supreme Court of the United States, October Term, 1911.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
vs.
THE STATE OF NEW JERSEY and THE PASSAIC VALLEY SEWAGE
COMMISSIONERS, Defendants.

Taking of Testimony at the Office of Messrs. Riker & Riker, Newark,
N. J., Friday — 21, 1913, 10:30 A. M.

Before: James D. Maher, Esq., Commissioner.

Appearances:

Thomas Carmody, Esq., Attorney General of the State of New
York;

William A. McQuaid, Esq., Deputy Attorney General;

Dr. William J. O'Sullivan, Special Counsel for the People of the
State of New York, Complainants.

Edmund Wilson, Esq., Attorney General of the State of New
Jersey;

Robert H. McCarter, Esq., of Counsel for the State of New Jersey;

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage
Commissioners, Defendants.

JOHN S. GIBSON, a witness called by the defendants being duly
sworn by the Commissioner, testifies as follows:

Direct examination by Mr. Riker:

Q. Where do you live?

A. In the city of Newark.

3872 Q. Have you any official connection with the Passaic Val-
ley Sewerage Commission?

A. Clerk for that body.

Q. How long have — been its *check*?

A. Since its inception in 1902.

Q. I hand you a paper dated New York, March 15, 1909, pur-
porting to be signed by Rudolph Hering, George W. Fuller and
Edlow W. Harrison, and ask you if you have had the custody of
that paper.

A. Yes, sir; I have had the custody of this document.

Q. Are you familiar with the signatures of Rudolph Hering,
George W. Fuller and Edlow W. Harrison?

A. I am.

Q. Are the signatures to that paper the signatures of those gentle-
men?

A. They are; yes, sir.

Mr. Riker: I offer this paper in evidence.

Dr. O'Sullivan: I object to the admission of this paper to evi-

dence, as it has not been proven, or any proper grounds laid for its admission.

The Commissioner: Note the objection of Counsel for the complainants.

Marked Defendants' Exhibit 5.

Q. Do you know whether a contract has been entered into between the Passaic Valley Sewerage Commission and certain municipalities lying within the district?

A. I do; yes, sir.

Q. What is it? Do you know the date?

A. September 20, 1911.

Q. Can you give the titles of the parties to the contract?

A. Yes, sir. The city of Newark; the town of Belleville; the town of Nutley; the city of Passaic; the township of Acquackanonk; the city of Paterson; the borough of Garfield; borough of Wallington; East Rutherford; Rutherford; the township of Union; borough of North Arlington; the town of Kearney; borough of East Newark, and the town of Harrison—fifteen in number.

Q. I show you a paper dated May 11 1910, purporting to be signed by J. M. Dickenson, Secretary of War, having annexed to it two photographic reproductions of plans, and a paper purporting to be a copy of a stipulation in this suit, dated the fourteenth day of April, 1910, and ask you whether you have had the custody of that paper.

A. I have.

Mr. Riker: This being the original permit from the Department of War for the construction of this sewer, I propose offering a copy of it certified by the War Department, and I now make that offer, substituting for it a copy made in this office, which I will now offer, and later a certified copy by the War Department, which I will ask to have marked Defendants' Exhibit 6.

Dr. O'Sullivan: Before you mark that in evidence, I would like to ask a few questions of the witness.

By Dr. O'Sullivan:

Q. Where did you receive the document, Mr. Gibson?

A. It came to me, I think, in the course of business while in the office; I couldn't exactly tell, it was handed over to me as one of the official documents of the Commission.

Q. Have you compared the copy that Mr. Riker offers in evidence, with the original document?

A. I have not.

Dr. O'Sullivan: I make formal objection to the document being received at this time as it has not been properly proved.

The Court: Note the objection of Counsel.

Mr. Riker: I may state that my purpose will be, as I said, to substitute the certified copy of the War Department; and I will, if you desire, so far as this particular instrument is concerned, I can have my office force certify that this is an examined copy in

3874 this office, and I only put this in subject to your examination—a copy of the paper at this time.
Marked Defendants' Exhibit 6.

By Mr. Riker:

Q. Now, Mr. Gibson, I show you a second paper, bearing date the twenty-second day of September, 1911, purporting to be signed by Robert Shaw Oliver, Acting Secretary of War, and marked on the back "Office Secretary War Department, September 21, 1911, 17201"
-061 and also "Office Chief of Engineers, War Department, September 22, 1911, 220103"
198 and ask you whether that paper has been in your custody as Secretary to the Commissioners.

A. Yes, sir, that paper has been in my custody.

Mr. Riker: I propose substituting for a copy which I produce here, a certified copy of that paper, and meanwhile I will put in, for the examination of Counsel, a copy which has been examined in this office, a true copy, and will substitute later a true copy. The reason why the original papers produced are not placed in the exhibits is that they are original official documents from the War Department authorizing the construction of this sewer and its discharge into New York Bay and that if they are put in as exhibits they are taken out of the files of the Commissioners. I am offering now and ask the Commissioner to mark as Defendants' Exhibit 7, the office copy which I produce of this particular paper, with the understanding I will substitute a certified copy from the War Department in its place.

Dr. O'Sullivan: I make formal objection to the admission of this document on the ground that it has not been properly proven, nor proper grounds laid for its reception as evidence in this case.

The Court: Note the objection of Counsel.
Marked Defendants' Exhibit 7.

3875 Cross-examination by Dr. O'Sullivan:

Mr. Gibson, this first paper that was offered in evidence—
The Commissioner: Defendant's Exhibit No. 5.

Q. The Hering Letter—the Hering-Fuller-Harrison letter of March 25, 1909, have you any knowledge of the truth or accuracy of the statements contained in that document, which is dated New York, March 25, 1909, and signed by Rudolph Hering, George W. Fuller and Edlow W. Harrison?

A. I have not; no, sir. I am not familiar with the things treated.

Q. Directing your attention to page 3 of that document, under the caption "Estimated degree of removal of floating and suspended matter" I ask you whether or not you know to be true the statement "The very finely divided, suspended, organic particles and dissolved organic matters in the sewage will, under the proposed con-

ditions of dispersion, be carried into the water until they are adequately oxidized, or mineralized, or consumed by low forms of marine life."

A. You ask me what, in reference to it?

Question repeated.

A. I do not; no, sir. Not familiar with the subject at all.

Dr. O'Sullivan: That is all.

The Commissioner: Shall we adjourn, subject to the call of Commissioner?

Dr. O'Sullivan: Mr. Riker has something to say? Does the defendant rest?

Mr. Riker: The defendant has no further evidence today. If further evidence is to be put in, they will try to arrange for a further hearing before the first of March. My belief is that we shall not desire to offer any further evidence.

Dr. O'Sullivan: I understand that the defendant rests?

Mr. Riker: Unless we put in further evidence before the 3876 first of March, the Defendant will have rested.

The Commissioner: We will adjourn, now, subject to the call of the Commissioner on notice from Counsel for both sides.

Whereupon, at 11:30 A. M., the Commissioner adjourned the hearing, subject to call.

3877 Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against

THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

NEW YORK CITY, May 19th, 1913.

Before James D. Maher, Esq., Commissioner.

Appearances:

Thomas Carimody, Esq., Attorney General of the State of New York;

Dr. William J. O'Sullivan, Special Counsel to the People of the State of New York, Complainants;

Edmund Wilson, Esq., Attorney General of the State of New Jersey;

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

The Commissioner: Pursuant to the notice heretofore served on Counsel by the Commissioner, testimony for the Complainants in rebuttal was begun.

JAMES J. POWERS a witness called in behalf of the Complainants in rebuttal, being duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Mr. Powers?

A. James J. Powers.

Q. Where do you reside?

A. 901 Madison Avenue, Elizabeth, New Jersey.

3878 Q. What is your business, Mr. Powers?

A. My business is contracting engineer in sanitary and hydraulic work, and specialist in sewage purification.

Q. What sewage disposal works have you ever installed and operated?

A. Brighton Beach, Coney Island, in 1879; West Brighton Beach, Coney Island, 1885 to 1889; Virginia Beach, Virginia in 1890; White Plains, New York, 1890 to 1892; Sheephead Bay, New York, 1890 to 1892; Seville, Florida, 1888; Round Lake, New York, 1888; Far Rockaway, New York, 1896-1897; Brooklyn, New York, 26th Ward, 1895; Bath, New York, Steuben County, 1895; sewage purification works, New York State Soldiers and Sailors Home; also sewage purification and water supply at Davenport Orphans Home. Honesdale, Pennsylvania, sanitary inspection, disinfection and improvements during the following typhoid fever epidemic in 1887. Brooklyn City, 1884: Chief Inspector of drainage and plumbing, Department of Health, City of Brooklyn, and (1882-1886) Examiner of Plans for sewerage and in charge of visiting inspectors in infected district during typhoid fever epidemic in 1884 and premises to which infectious diseases recurred or prevailed from 1874 to 1886. Fire Island, 1898: In charge of sanitary construction and repair at Fire Island preparing camp for sick soldiers of New York State invalided from the Spanish War in Cuba. Mount Vernon, 1898: Engineer in charge of sanitary improvement of sewers and water supply at Mount Vernon, New York, Infants Asylum, following outbreak of diptheria. Jamaica, Borough of Queens, 1901: Sewage purification works at Jamaica, Queens Borough, New York,—Sewage disposal and sanitary works at isolated places in Florida, New Hampshire, Vermont, Connecticut, New Jersey, Rhode Island, Pennsylvania, New York and Ohio.

3879 Q. Now, what sanitary work have you been engaged on since 1872?

A. My practical construction experience in sanitary work began in 1872 and since that time I have been actively engaged in practical work. In 1881 I invented and patented the first method of anti-septic sewage treatment and dispersion by subsoil irrigation used in America, and since that time I have continually studied to secure better results and have taken out 10 patents in all relating to the subject and have carefully observed the operation of my various plants and experiments to secure greater practical efficiency in clarification, sterility and dispersion. These are copies of the various patents (producing papers).

Q. What personal knowledge have you of conditions in the Passaic River and the Passaic Valley?

Mr. Riker: The question is objected to on the ground that it is irrelevant.

The Commissioner: Note the objection of Counsel for Defendants.

The Witness: I have personal general knowledge of the conditions in the Passaic River and Valley, having interested myself therein at intervals for the past 15 years, more particularly during the past 7 years, and have written on the subject for the press and spoken at public hearings in an effort to induce the authorities to treat their sewage by precipitation and sludge removal, being actuated thereto by my speciality interest and also by my interest as a citizen and sanitarian to prevent what I believe to be an error of judgment and which I also believe to be a practical retrogression in sanitation. To select the Harbor of New York for further experiment in an effort to render sewage innocuous by dilution seems a great error, when the resultant effect, if unfavorable, will seriously impair the hygienic, piscatorial and navigable advantages of a great harbor. It is perfectly practicable to conduct the necessary experiments in Newark Bay, at much less expense and less injury to navigation and hygienic offense.

Q. Have you made any special study of the meteorological data referring to the Upper New York Bay?

Mr. Riker: The question is objected to inasmuch as it is not directed to the rebuttal of any testimony given on behalf of the defendants.

The Commissioner: Note the objection of Counsel for the Defendants.

The Witness: Yes. I have obtained from the United States Department of Agriculture, Weather Bureau, in New York, their data, the Annual Meteorological Summary of 1911 and 1912, with comparative data published by authority of Willis L. Moore, Chief, United States Weather Bureau, and compiled under the direction of James H. Starr, and from that data on page 11, I have prepared a chart indicating wind directions as given in the Meteorological Reports which I now offer.

Q. Taking the data from the source that you have just described, have you caused the subject matter in these reports to be plotted or graphically set forth on any map?

A. I have.

Q. On what map?

A. On the Hydrographic Chart of New York Harbor.

Q. Where did you get that Hydrographic Chart?

A. From the Hydrographic Bureau of the United States through the Custom House in the City of New York.

Q. And what is shown on that map in addition to the matters that were on it when you received the map?

3881 Mr. Riker: Same objection to that question as to the last question.

The Witness: There are arrows indicating the wind directions as described in the Report of the Meteorological Bureau, and also a legend stating what was done.

Q. Who prepared those additions to that map?

A. I did.

Mr. O'Sullivan: I offer the map described by this witness in evidence and ask that it be marked Complainants' Exhibit No. 198.

Cross-examination by Mr. Riker:

Q. Did you have any part, Mr. Powers, in getting the data, upon which you say this map was prepared?

A. Do I understand obtaining the data of the chart itself?

Mr. Riker: Will you read that question?

(The question was read by the stenographer)

The Witness: Why, yes.

Q. What part?

A. I obtained the report of the Meteorological Bureau and obtained the maps and studied them.

Mr. Riker: Read that question again. I would like you to answer the question, Mr. Powers.

The Witness: I will try to if I understand it.

(The question was again read by the stenographer)

The Witness: Yes, sir.

Q. Anything else except what you have described?

A. No, sir.

Q. You call that getting the data, do you, getting it from somebody else?

A. The data that I wished to place on it, which I wished to present.

Q. You understand the data to be that pamphlet, do you?

A. I understand the data to be the arrows and wind directions that I have put on the map which were copied from this data.

Q. Well, did you have anything to do with obtaining the 3882 facts which you have used as the data for the preparation of this map?

A. No.

Q. Now, what part did you have in the making of the map itself?

A. Marking of the map itself?

Q. As presented, yes, sir?

A. As presented?

Q. Surely?

A. The placing of the arrows and the legend on it.

Q. You did that yourself?

A. I placed them on and my assistant copied them in under my direction, in my presence.

Q. Well, if he placed them on, how did it happen he copied them in?

A. I placed them on in lead pencil and he copied them in ink.

Q. He inked them in?

A. Yes, sir.

Q. Did you see him do it?

A. Yes, sir.

Mr. Riker: The map is objected to on the ground that it does not contain any original material within the knowledge of this witness; on the further ground that it is not rebuttal of any testimony offered on behalf of the Defendants.

The Commissioner: Note the objection of Counsel for Defendants.

The map was received in evidence and marked Complainant's Exhibit No. 198.

Direct examination by Mr. O'Sullivan (resumed):

Q. Will you describe, Mr. Powers what these arrows and this legend mean or signify?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

The Witness: On page 11 of the Annual Meteorological Summary—

Q. For what year?

A. For 1912. The second table, the heading, reads as follows: "Wind direction. Monthly and Annual percentage found (Period 1894-1903 inclusive)". That table gives by percentage the prevailing winds during the several months during that time. I have indicated from that table on here (indicating) by arrows the direction of those winds.

Q. And what color are those arrows?

A. Red.

Q. Have you placed the percentage of prevailing winds there in connection with these arrows?

A. I have, yes, sir.

Q. Are you familiar with the conditions in Boston Harbor and in New York Upper Bay?

A. I am.

Q. Will you compare these conditions?

Mr. Riker: The question is objected to.

Q. On the question of dilution particularly?

Mr. Riker: The question is objected to on the ground that it is not directed to any testimony given on behalf of the Defendants and it is not rebuttal.

The Commissioner: Note the objection of Counsel for Defendants.

The Witness: The Harbor of Boston, which has a dilution content of 279 cubic feet per 1,000 of population, is unsatisfactory. That I have taken from the Report of the Massachusetts State Board of Health—

Q. For what year?

A. 1900, pages 512, 70, and 71. Page 5: (reading) "At the outlet near Deer Island Beacon, which is four and two thirds miles from Long Wharf, in Boston, and in the northerly edge of the Main Ship Channel, sewage from the North Metropolitan District is allowed to discharge as it comes at all stages of the tide. The quantity of sewage discharged in 24 hours now reaches about 3884 50,000,000 gals., and this quantity, while distinctly visible along the northerly edge of the Channel for a half a mile towards the City on the incoming tide and towards the sea on the outgoing tide, gradually becomes less distinct at greater distances."

Mr. Riker: One moment. Now, I object to the Witness' reading from this report without its being proved. If the report is admissible, it should be offered.

The Commissioner: Note the objection of Counsel for Defendants.

The Witness: Page 12: "At a time when the average quantity of sewage flowing from the outlet amounted to about 42,000,000 gallons a day, showed us that sewage could be traced for a distance of only about a mile from the outlet on the incoming tide, and for about one and one eighth miles from the outlet on the outgoing tide, and these results have been confirmed by further investigations made recently by the State Board of Health."

Page 70: "The mingling of the sewage with the water takes place all over the area covered by the sewage, but goes on more rapidly near the edges of the area than elsewhere. The sewage remains quite close to the surface of the water, which is covered for a time with a greasy film. This film appears to be very thin and sometimes extends considerably beyond the area otherwise affected by the sewage. It is apparently composed of grease or oil from the sewage, and it is most noticeable on calm days. The observations indicate that, the greater the quantity of sewage that is discharged from the reservoir, the greater will be the area of the harbor that will be covered with sewage and the area covered will ap- 3885 parently increase in more than direct proportion to the quantity of sewage discharged. It is not likely that any considerable proportion of the sewage would pass out the harbor north of Long Island."

Page 71: (Same Report) "With the present quantity, the sewage has been found to be recognizable for nearly two hours and a half after the discharge at the outlet has ceased."

Q. Now, what would be the dilution in New York Harbor and will you compare these two sets of conditions in Boston Harbor and in New York Upper Bay.

Mr. Riker: The question is objected to on the same grounds as those urged on the last question.

The Commissioner: Note the objection of Counsel for Defendants.

The Witness: The Harbor of Boston has a dilution content of

279 cubic feet per 1,000 of population. In New York Harbor it has only 72 cubic feet dilution per 1,000 of population, or less than one-fourth the dilution in Boston Harbor.

Q. What do you infer from that condition?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

The Witness: That if they cannot produce a satisfactory result in Boston Harbor with a dilution of 279 cubic feet per 1,000 of population they certainly cannot get a satisfactory inoffensive result in New York Harbor with a dilution of 72 cubic feet per 1,000 of population.

Q. Have you devoted any attention to the self-purification of waters?

3886 Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. I have. Streams that a few years ago were certified to as having capacity of self-purification are to-day putrid channels of filthy water and their beds reservoirs of putrid slimy deposit.

Q. How does that apply to New York Harbor?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

The Witness: The only way this result can be prevented in New York Harbor is by causing the precipitation, coagulation and chemical combinations that result from admixture of sewage with salt water to occur in the deposition tanks at the Newark sewage treatment works, or in Newark Bay, and provide as far as possible against secondary reactions that induce injurious combinations. It has been found in practice that the per capita dilution that was supposed to dilute sewage to inoffensiveness is today inadequate and even an amount of dilution one hundred times greater is totally incapable of depriving sewage of its offensive character; and as a matter of fact there can really be no dilution of sewage solids until they have decomposed, then the gaseous products of their decomposition will be absorbed by the diluent and the result will be a stinking diluent. The present condition of the Passaic River shows putrescibility of its contents for the entire length, and this result has occurred within twenty-five years. I judged there that this result has occurred within 25 years and to verify that I quote from Slater Sewage Treatment Purification and Utilization in a statement made by Professor A. R. Leeds, Ph. D. where he says: "In proof of the efficacy"——

3887 Mr. Riker: Now, I object to the use of this matter as not being properly proved in any way, not being evidence and not being rebuttal of anything in Defendants' testimony.

The Commissioner: Note the objection of Counsel for the Defendants.

The Witness: "In proof of the efficacy of these natural agencies,

he refers to the River Passaic pure above the Town of Paterson, but polluted by the sewage and the manufacturing refuse of that town. he writes:—'The river immediately below the town is black with dye-wares, the fish carried over the Great Falls are immediately poisoned, and I have seen the foul smelling and disgusting water covered with their floating carcasses.' Yet samples of water taken at intervals of a mile apart down the river show a regular decrease in the organic pollution, and an improvement in the quality, until at a point 16 miles below Paterson, the river has returned to a condition of purity not much inferior to that which it exhibited above Paterson, and at this point it is used as a water supply for the 300,000 inhabitants of Jersey City and Newark."

Q. What year was that published, that book?

A. 1888.

Q. Have you given the full title of the book?

A. Yes.

Q. I hand you Mr. Powers, Defendants' Exhibit No. 5 (handing witness paper) and ask if you have studied the effluent that is proposed in that exhibit to be discharged in New York Harbor at Robbins Reef, and if so, with what result?

A. Yes, I have. It is proposed in this exhibit to discharge 3888 an effluent into the Harbor of New York at Robbins Reef that has passed through grit chambers where heavy matters may deposit, if they will, then screened through a series of screens. First coarse screens placed in the flow to arrest the coarse matter and then pumped into a screen with mesh openings of 4/10-inch, through which it passes into tanks, where it deposits any sediment that will deposit during a flow of 15 feet per minute through the tank. In practical operation as a matter of fact the sewage will arrive at the sewer works after a flow of many miles. A large percentage of it has already been pumped. The whole has had the friction, attrition and resistance incident to such flow, the result being, of course, that all the feces will be broken up into small particles, all of which will readily pass through screens of 4/10-inch mesh.

The rags, paper, pieces of soap, vegetable refuse and solidified grease having more resistance to separation will be arrested in the screens, provided it is found possible to operate them. In practical operation there will be tons of lint, shreds of fibre from the silk, cloth-finishing, dyeing and leather works and the laundry operations incident to a population of 734,396 persons in the district which this sewer will serve.

Q. Now, based on your practical experience what do you infer from that?

A. Based on my own practical experience in screening sewage during the past 40 years—is that the screens will foul so rapidly that they will have to be dispersed with and that all the excreta will pass through the screens.

3889 If there is no provision made for precipitation or disinfection, the settling tanks will contain all the feces and grease in an advanced state of offensive decomposition, part of it

floating and part on the bottom, and the intervening depth of semi-fluid filled with flocculent matter in a transition state, alternately falling and rising as they become gaseous.

A large part of the contents will be a slimy, mucilaginous mass of partly dissolved feces, grease, and pulpy residuum that certainly should have some treatment, either filtration, precipitation, or admixture, to make the fluid portion fit for discharging into the outlet sewer.

Q. Now, will you extend your experience to the drawing off of the effluent from these settling tanks?

A. Well, based on my own experience in drawing off the effluent from settling tanks in several large plants that I installed and observed, if it gets no further treatment before discharge, the greater part of the flocculent matter will be discharged with the effluent.

Q. I hand you Complainants' Exhibit No. 135, Mr. Powers, and ask you if you have studied that exhibit?

A. I have, sir; I have seen a copy of this.

Q. You have had a copy of it and studied it?

A. I have had a copy of it and studied it.

Q. Can the results stipulated for in that exhibit be produced by the plant described therein?

Mr. Riker: The question is objected to on the ground that this exhibit was under direct examination in Complainants' direct case and has been the subject of a number of witnesses' opinions and that this evidence that is sought from this witness is not rebuttal
3890 of anything that has been adduced in Defendants' case.

The Commissioner: Note the objection of Counsel for Defendants.

Mr. O'Sullivan: Complainants' Counsel presses this line of inquiry because this particular exhibit was discussed by a witness produced by the defense, Mr. George A. Johnson. Read the question.

(The stenographer thereupon read the question.)

The Witness: No, without treatment of the effluent it will be impossible to comply with the stipulation, that is stipulation No. 135 entered into with the United States, because in silk throwing and silk dyeing there is used in the City of Paterson alone more than seven million pounds of soap. A large percentage of this is not recovered and the Hazen report states on page 17, Appendix I, paragraph 2, that this amount of soap solution must discharge into the sewer as it is too impure to put into the river. While this solution is not objectionable in the sewer, it is highly so in the harbor. The addition of salt or its discharge into salt water will result in the formation of soap granules and an insoluble calcium stearate which will color the salt water into which it is discharged and create a floating scum.

Q. How would the maceration of these solids and then forcing them through a 4/10th-inch mesh affect the sewage to be treated and the resultant effluent.

Mr. Riker: The question is objected to as not being rebuttal and

not directed to any specific part of the testimony of the defendants.

3891 The Commissioner: Note the objection.

The Witness. To macerate these solids by forcing them through 4/10-inch mesh screens and form a jelly that in no way changes the harmful nature of the solids and causes more rapid consumption of oxygen at the discharge point has no value. The solids should be removed in the works on the Newark Meadows, the soap liquid coagulated, and all this matter precipitated before discharge of the effluent, so that a great nuisance shall not be inflicted on a neighboring state.

Extensions of this nuisance from Newark Bay to Robbins Reef will have no remedial value. The problem should be solved at the place where the nuisance is created and not shifted into an adjoining state for solution.

Q. Where do you expect the effluent to be discharged, Mr. Powers?

A. At Robbins Reef.

Mr. Riker: Do you know that is in New Jersey?

The Witness: Yes, sir.

Q. Do you understand that the effluent is to be discharged into the Main Ship Channel in New York Upper Bay?

A. Yes.

Q. And with sufficient force to carry it across the current of the Main Ship Channel?

A. Yes, I understand that is provided for in the specifications.

Q. And that the boundary line of the states is in that Main Ship Channel?

A. I do.

Q. You mentioned something about precipitation. How long has that necessity for precipitation been recognized, Mr. Powers?

A. The necessity for precipitation has been recognized since 3892 1763, at which time it was first proposed by De Boissieu.

About 1780, and since that time, the treatment of sewage to prevent the discharge of solids into streams and bays has been generally recognized and recommended in almost every case where sewage disposal has been considered. Eminent men, all of whom had given much study to the question, have invariably recommended treatment of the sewage effluent by some method before discharge. The few who in previous years recommended dilution without treatment have had ample opportunity in recent years to observe the effect of their errors and the injury and nuisance that has resulted from reliance on dilution without removal of the solids. Where eminent men have stated that sewage could be digested in water by dilutions varying from 3 to 20 they of course have assumed that the sewage supply would not be continuous and that additional sewage would not be added during the distance of the flow that they prescribe, and when additional quantities have been added during the length of said flow, of course the primary requirements would be violated and the necessity created for further dilution and longer flow. For example: if sewage is discharged into a stream

or bay and after flowing for 3 or 4 miles that additional sewage should be added, the effect would be to nullify the digestive operations which the primary discharge was undergoing.

During recent years the increased pollution of streams has attracted greater attention from the governing bodies and the scientists because of the monetary damages for riparian rights injured, fishery interests destroyed, and the nuisances created by emanations from the putrefying mass.

3893 As an example of the impossibility of the dilution of solids,

I wish to state that sanitary authorities generally require that water-closets shall be flushed from individual tanks having a capacity of from 7 and a half to 10 gallons; and this quantity is discharged with each use of the closet; as the amount of dejecta in such use is but one-sixth of a pound and it is discharged into and with 62 and a half pounds of water the dilution at the time of use alone is 372 to 1. As the sewage discharge of residential and manufacturing places is generally 100 or more gallons per head of population and the fecal discharge is one-sixth of a pound, there is a further dilution of 833 pounds of water to one-sixth pound of fecal matter, or a dilution of 5000 to 1. If it were possible to dilute solids this amount of water dilution would certainly dispose of them, but as they are not soluble until after they have putrefied or been macerated, it follows that you cannot dilute this matter while in a fresh condition, and they should be separated from the fluids so that their progressive decomposition and the resultant gases therefrom, which are soluble, may not impregnate the fluid. In my opinion this separation cannot be affected by screening, because these matters and also the grease, while they may have a form, have very little cohesion, and any mechanical manipulation of them readily tends to break them up. The settlement is best effected by sedimentation, but precipitants and inertia are absolutely necessary to obtain a satisfactory result. Standard authorities give 25 tons of feces and 45 tons of urine per 1,000 of population. As the population in the sewerage district—as given in the Passaic Valley Sewerage Commissioners' Report of 1908, page 8, is

3894 702,000 persons in 1911, and the estimated increase about 31 per cent., I have taken 744,000 persons in the district at the present time as a basis of estimate. From the above number of persons the discharge of feces would be 18,600 tons per year and 282,720 tons of urine per year, or 1,500 tons of feces per month and 2,790 tons of urine per month, or 51.66 tons of feces and 93 tons of urine per day, which would be carried to the works on Newark Meadows, mixed with 75,000,000 gallons of water, allowing 100 gallons per head of population per day. There would also be contained in the sewage water many thousand pounds of soap liquid.

Q. Any trade wastes?

A. Well, I include in trade wastes everything that is for manufacturing interests in my view of it. It would appear that in addition to the soap solution from laundry and domestic wastes, from the large silk treatment works, and from the small silk throwing,

cloth and other manufacturing intetrests that use soap, there would be in solution in the daily discharge many tons of soap.

This enormous amount of soap solution would seriously affect the provision in the stipulation of the Passaic Valley Sewerage Commission with the United States, wherein the Passaic Valley Sewerage Commission has agreed that the effluent discharged by them at Robbins Reef will create no discoloration of the waters of the harbor. It is impossible to discharge this amount of soap solution into salt water without creating soap granules and scum upon the surface; the mere admixture of the soap solution with the salt water produces coagulation and an insoluble calcium stearate, which will spread out on the sufrage of the harbor and certainly create discoloration.

Now, in verification of that, I would like to refer to Report on 3895 Sewage Disposal of the City of Paterson, June 30th, 1906.

The following is from page 93, paragraph 5, Report on Sewage Disposal of Paterson, New Jersey: "It must be admitted that New York is better off without the discharge of New Jersey's sewage. The discharge of sewage will tend to pollute the Bay locally. There will be an appearance of sewage for some distance around the proposed outlet, and this outlet is near the Main Channel of the Harbor. There will be some odor and grease, for the sewage will smooth the waves and show its presence over a considerable area."

Q. Now what benefit would you expect to flow from carrying this effluent from the sewage disposal works on the Newark Meadows to Robbins Reef for the discharge?

Mr. Riker: It is objected to on the ground that it is not rebuttal of any evidence offered in behalf of the Defendants.

The Commissioner: Note the objection.

The Witness: There is no benefit that can result from carrying the effluent through the tunnel. There is no additional treatment admixture with any agent or sedimentation that could in any way improve the effluent from the time it leaves the Newark Meadows works until it is discharged at Robbins Reef. If this effluent, when it issues from the works on Newark Meadows, is an inoffensive clarified effluent incapable of offense, why is it necessary to spend several million dollars in conveying it several miles to Robbins Reef? If it is inoffensive, there is no objection whatever to discharging it into Newark Bay; in fact if it is a well clarified effluent it will improve the condition of the bay. There will be a 3896 great saving of money if the tunnel to Robbins Reef is omitted until such time as by experimentation in the actual operation of the works it shall have been demonstrated that there is either no objection or no necessity for continuing to Robbins Reef.

This omission of the tunnel to New York Bay was suggested by Hon. Andrew F. McBride on page 7 of his special message to the Municipal Boards of the City of Paterson in 1910.

Q. Have you got a copy of that message?

A. I have, (producing paper).

Q. How did you get this copy of the Special Message of Mayor Andrew F. McBride?

A. I asked him for one before it was printed and he said that he would mail me one as soon as it was printed and did so.

Q. Was his signature attached to it?

... Yes, sir.

Mr. O'Sullivan: I offer that in evidence and I ask that it be marked Complainants' Exhibit No. 199.

Mr. Riker: The offer is objected to on the ground that it is irrelevant, incompetent and immaterial.

Received in evidence and marked Complainants' Exhibit No. 199.

Q. What special portion of Complainants' Exhibit No. 199 did you wish attention to be directed to in support of the statement that you have just made previously, Mr. Powers?

Mr. Riker: The question is objected to on the ground that it deals with a matter not even touched in Defendants' evidence and is not rebuttal.

The Commissioner: Note the objection.

Mr. O'Sullivan: Complainants' Counsel presses this *this* 3897 line of inquiry in line with that provision of the Laws of the State of New Jersey for the year 1907, being Chapter 10 of the Laws of 1907, the 9th section of that law providing in its last paragraph for the taking over by the Passaic Valley Sewerage Commissioners of all plans, maps, data and reports which it may have produced, purchased or secured relating to those secured, purchased and produced by the City of Paterson, and in which there is provision for compensation also to the City of Paterson. This being one of the special messages, forms a part of the records of the Passaic Valley Sewerage Commission. Read my question to the witness.
(The stenographer thereupon read the question.)

The Witness: 5th paragraph, page 7. Shall I read it?

Q. Yes.

A. (Reading:) "The main question of disposal of the sewage has not been decided. If a trunk sewer can be built for the money reported by the Sewerage Commission and permission can be had to empty the same into New York Bay without purification works, then Paterson should join in the plan. If the sewage must be purified, as we have every reason to believe, then there is no reason for extending the sewer to New York Bay. The great expense of a tunnel to New York Bay should be avoided and the purification works built on Newark Meadows."

Q. An effluent such as you state would be likely to be produced by the plan described in Complainants' Exhibit No. 135, how would you expect such an effluent to affect the navigability of New York Upper Bay and the Harbor of New York.

Mr. Riker: The question is objected to on the ground that it is not rebuttal of any evidence offered on the part of the defendants and further because it deals with a matter exclusively within the

jurisdiction of the War Department of the United States
3898 Government, who are not concerned in this suit.

The Commissioner: Note the objection.

The Witness: Read that question again, please.

(The stenographer thereupon read the question.)

The Witness: Well, this would be the effluent there—it would simply affect the appearance of it and to injuriously affect the appearance or salubrity, or impair the navigability of the Harbor of New York, would give offense to the Merchant Marine of the world who all navigate these waters.

Q. Are you familiar with the conditions in the Chicago Drainage Canal?

Mr. Riker: The question is objected to as immaterial and irrelevant; not rebuttal of any evidence offered on the part of the Defendants.

The Commissioner: Note the objection.

The Witness: I have examined the report and read considerable regarding it, and I understand that the Chicago Canal Commissioners had applied to the Hon. Henry L. Stimson, Secretary of War, for 200 per cent. more water than they originally were allowed and that that was denied.

Q. Well, before we go to that, Mr. Powers: what occurs when streams of fresh water discharge into salt water—the fresh water streams being polluted?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

The Witness: Many things occur; but it is a matter of general knowledge that streams of fresh water discharging into salt, do not enter into combination at once, but must flow for long distances to obtain the necessary agitation that causes them to combine
3899 and that during that flow they are recognizable by color.

Q. Would you expect that to occur in the proposed discharge at Robbins Reef?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

The Witness: In the proposed sewage discharge at Robbins Reef there will be a conspicuous bubbling over the dispersion area and that there will be an offensive odor from the discharge also scum at this point and the surrounding area.

Q. Why?

A. Well, because there has been no antiseptic treatment of the effluent discharged, and of course in its passage along the several miles of tunnel, it will be undergoing fermentation and putrefaction, and when discharged, why, of course, it will have smell and color both. To discharge this amount of sewage into New York Bay without purification or clarification enough to render it innocuous before discharge, would be, in my opinion, a violation of

decency and sanitation, and unjust to the accumulated knowledge on this subject in this age.

Q. Now, have you read some of the testimony given by the witnesses for the defense in this suit?

A. Some.

Q. From your study and knowledge of the conditions and of the exhibits submitted to you, what in your opinion will result from the discharge of the effluent described as being produced by the plant outlined in Complainants' Exhibit No. 135?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

Mr. Riker: Further that the witness' attention should be drawn, that counsel may understand what he is testifying to, to the specific parts of the testimony which are sought to be rebutted and which has not been done in this case.

The Witness: Read the question, please.

(The question was read by the stenographer.)

The Witness: In that exhibit No. 135, no provision is made for precipitation by the admixture of any agent or filtration or anything that would tend to remove the flocculent matter from out of the effluent, and in my opinion there would be a discoloration and offense at all times at the point of discharge at Robbins Reef.

Q. Directing your attention again, Mr. Powers to Complainants' Exhibit No. 135, will the plant described in that exhibit produce an effluent which if discharged at Robbins Reef, will or will not occasion a nuisance?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

The Witness: I believe it will occasion a nuisance. I would like to say right there, that, there being no necessity for taking chances of creating a nuisance and as they have such a splendid opportunity to treat that sewage in some way on Newark Meadows that would be inoffensive, that I believe it should be done. Now, I have calculated the dilution by gallons in Boston Harbor, New York Harbor, the Chicago Drainage Canal at a dilution of 6 cubic feet per second flow. The Boston Harbor dilution contents is 279 cubic feet per second from 1,000 of population. 279 cubic feet per second is 2092 gallons and is 125,520 gallons — minute, or 7,531,200 per hour, and is 180,748,800 gallons in 24 hours. New York Harbor has 72 cubic feet per second for each 1,000 of population. 72 cubic feet per second is, 540 gallons per second, is 32,400 gallons per minute, is 1,944,000 gallons per hour, is 46,656,000 gallons per 24 hours, is 46,656 gallons of water for each person.

Q. What is the ratio of dilution in Chicago, the Chicago Drainage Canal?

A. The Chicago Drainage Canal has 1,000 cubic feet per second — for 1,000 cubic feet per second for each 300,000 of population.

The reason that they ask for that is stated in page 193 Appendix No. 2 of Lake Diversion at Chicago.

Q. By whom?

A. By Lyman E. Cooley.

Q. For what year?

A. 1913, February. He states therein on page 193: "The least amount of water necessary to render sewage innocuous by the dilution method has been estimated by well recognized sanitary experts as 1,000 feet per second.

Q. Cubic?

A. Cubic feet per second for every 300,000 inhabitants.

Q. Have you made any calculations on that?

A. I have. 1,000 cubic feet per second is 7,500 gallons per second, is 450,000 gallons per minutes is, 27,000,000 gallons per hour is 648,000,000 gallons in 24 hours,—2160 gallons per day for each person would amount to 648,000,000 in 24 hours.

Q. Have you made a calculation on dilution at 6 cubic feet per second?

—, I have, sir, by gallons, 6 cubic feet per second, 45 gallons per second, 2,700 gallons per minute, 162,000 gallons per hour, 3,888,000 gallons per 24 hours.

Q. Is that for each person?

A. No, that is for each 1,000 persons.

Q. For each 1,000 persons?

A. Yes.

Q. In relation to the map which you have prepared and admitted in evidence as Complainants' Exhibit No. 198, where would you expect depositions to occur from this effluent proposed to be 3902 discharged under Complainants' Exhibit No. 135?

Mr. Riker: Same objection; not being rebuttal.

The Commissioner: Note the objection.

The Witness: Well, that would depend on the direction of the wind. The various winds—several winds would carry the lighter particles to the—this being Robbins Reef at the point of discharge, a west wind would blow it towards Brooklyn, that is, Bay Ridge. The northwest wind would blow it in the same direction; a north wind would blow it towards the shores of Staten Island. Northeast wind would blow it towards the shores of Staten Island. A southwest wind would blow it up towards New York City.

Q. Meaning what?

A. Manhattan Island, and Governors Island and a northwest wind would also tend to blow it ashore at Fort Hamilton. Now, the drift of scum from my own personal knowledge—I speak now of scum, not of deposited solids—at this point here in Gravesend Bay, in the bight of Gravesend Bay, on the Coney Island Shore, there is generally a deposit of floating sea weed and so on. To my own knowledge, there are men there who make a business of collecting that sea weed and furnishing it to the Aquarium for use.

Q. Have you had any direct personal experience with floating

matters that were blown on to the Brooklyn shores causing infection of any kind.

Mr. Riker: Same objection.

The Commissioner: Note the objection.

The Witness: Well, I have had no personal experience, but it is stated in the Medical Report, of the yellow fever of 1856, 2003 that the infection at Bay Ridge was from vessels anchored at Quarantine, and that all the cases of yellow fever that occurred there were within 50 or 60 yards of the Beach. Of course, I have no personal knowledge of that. That is in 1856.

Mr. O'Sullivan: He is your witness, Mr. Riker.

Cross-examination by Mr. Riker:

Q. Well, Mr. Powers, you have characterized with some adjectives, the proposed discharge of an effluent from the Sewage Disposal Works of the Passaic Valley Sewerage Commissioners into New York Bay at Robbins Reef. What adjectives would you use for the discharge of crude sewage by the City of New York directly into the waters of New York Bay?

A. It is perfectly inexcusable in this age.

Q. Do you recall the adjectives you used with reference to the New Jersey discharge?

A. I do not.

Q. Would you apply the same or stronger ones to the discharge of crude sewage by New York City in the water of New York Bay?

A. I would.

Q. How far from the line dividing the State of New York and the State of New Jersey is the nearest outlet proposed for the Passaic Valley Sewer?

A. Well, no, I did not measure that and could not state it for a fact at all.

Q. Well, when you say the sewage is to be discharged across the Channel into New York Bay, or into the territory of New York, can you tell whether that will be so or not, without knowing the distance?

A. That is a statement in the Passaic Valley Sewerage Commission's Report for 1908 in the plan.

Q. Will you point it out?

A. Yes, sir; on page 21 of the Passaic Valley Sewerage Commission's Report (indicating.)

2004 Mr. O'Sullivan: Of what year?

The Witness: 1908, fourth paragraph, page 21. (Reading): "At a point in the rock north of the lighthouse the single sewer will be extended by a number of smaller outlet pipes at right angles to the extended of sea water, so as to get the greatest possible dispersion over a large area."

Q. Yes, you interpret that to mean that it will discharge across the line, do you, into the territory of New York?

A. No, no.

Q. Isn't that what you say?

A. No.

Q. You didn't intend to say that?

A. No, sir.

Q. You simply intended to say that the direction is across the Channel as it states there (indicating)?

A. As it states there (indicating): I don't dispute that.

Q. Do you mean to say that discharge will carry the sewage directly across the Channel for a distance of a quarter of a mile?

A. It will depend, of course, upon the inflowing and outflowing tides; the currents and the deflections that it meets.

Q. I want to know whether in your opinion the discharge, as a distinguishable discharge, from the outlet to the Passaic Sewer in your judgment will carry a distance of a quarter of a mile through the waters of New York Bay?

A. I believe it will.

Q. You think that there will be a well defined stream of sewage, which will extend across the Channel of the Main Ship Canal for a distance of a quarter of a mile, do you?

A. I do.

Q. Have you ever seen any such thing happen?

A. Yes.

Q. Where?

A. At Coney Island. In 1896 we carried the force main discharge outlet down to the foot of 23rd Street and discharged
3905 at that point, and the well defined trail of it was seen out through there.

Q. Well, a well defined trail, what do you mean by that?

A. Well, a path, if you choose.

Q. On the surface?

A. Well, that is, of course, only the surface was visible and you could not see below.

Q. How deep do you understand the discharge outlets of the Passaic Valley Sewer are to be?

A. 40 feet below low water.

Q. And in your opinion there is enough hydraulic pressure on that outlet line to force the sewage at right angles across the Channel into the waters of New York Bay?

A. There is—it would be more in the dispersion there. There would be, as I understand it, about 12 to 15 feet hydraulic head on the discharge, but as it flowed up and on the current, it would go where the current was going.

Q. So that, after all, what you mean, is that in your opinion, these sewage matters will finally disperse so it will reach New York water?

A. Yes, sir.

Q. And that is all you mean?

A. Yes, sir.

Q. What was the date of the report on sewage in Paterson that you read?

A. That was the Passaic Valley—no, the Report on Sewage Disposal of Paterson, New Jersey, 1906.

Q. Will you turn to the stipulation which is Exhibit No. 135 for the Complainants, and see what the date of that is?

A. (Reading.) This is the 14th day of April 1910.

Q. In your opinion an effluent which will not in any way be objectionable in Newark Bay, will that same effluent be objectionable in New York Bay?

Mr. O'Sullivan: Read that please.

3906 (The stenographer thereupon read the question).

The Witness: I think that I understand the gentleman's question.

Q. Well, I think it is perfectly clear; I think you might understand it. If it is not, I will re-frame it.

A. If the effluent is unobjectionable in Newark Bay, it would certainly not be in New York Bay.

Q. Don't you understand that Newark Bay is part of New York Harbor?

A. I did not.

Q. You did not understand that. Well, from the point of view of an expert to the results in the water, what difference does it make, whether it costs the Passaic Valley Sewerage Commissioners more money or less in your opinion, so far as the results upon the health and the appearance of the water are concerned?

A. Read that question.

(The stenographer thereupon read the question).

The Witness: I don't see that it concerns an expert at all regarding the expense.

Q. Well, what have you got to do with the question of whether it costs money or not, to run a tunnel out into New York Bay—as an expert?

A. Oh, as an expert?

Q. Yes.

A. Why, I believe that with the treatment that is described in Exhibit No. 135, that that effluent will be a nuisance in New York Bay, and I would be very much opposed to having it go there. If it was thoroughly clarified, of course, there would be no objection and I would have none.

Q. Yes, but what have you got to do as an expert with the cost of the outfall alone in New York Harbor or New York Bay?

A. I am a resident of the State of New Jersey.

3907 Q. Yes?

A. My family own property there and I would have the same interests that any other citizen would have, that is, in obtaining as good results as possible at the least expenditure possible to obtain.

Q. Have you got any property in the Passaic Valley Sewerage District?

A. In the Passaic Valley Sewerage District?

Q. In the Passaic Valley Sewerage District?

A. In the district?

Q. Yes, sir; I said the Passaic Valley Sewerage District?

A. No, sir.

Q. Well, how does it concern you what the district spends?

A. I don't see that it does.

Q. Now, Mr. Powers, assuming that the effluent produced and discharged by the Passaic Valley Sewer System is of the character which is specified in the second general paragraph of Complainants' Exhibit No. 135, are you still of the opinion that there will be a nuisance created in New York Bay by the discharge of that sewage?

A. Let me have that question again, please?

(The stenographer thereupon read the question).

The Witness: If it was of this character——

Q. That is what I said?

A. There would be no objection.

Q. Then the difficulty with you is that you don't agree with Mr. Hering and Mr. Fuller and Mr. Harrison, who have signed Defendants' Exhibit No. 5, that the processes described in the first part of that stipulation would produce that effluent?

A. Yes, sir, I differ with them on that.

Q. You differ with them on that. Who is Mr. Rudolph Hering, did you ever hear of him?

A. Yes, sir, I have known him for about 30 years.

3908 Q. Yes, sir, what is his profession?

A. He is an engineer.

Q. What kind of engineer?

A. A very eminent one.

Q. In what line?

A. In hydraulic and sewerage works.

Q. And Mr. George W. Fuller, do you happen to know him?

A. I have met Mr. Fuller; he is a very eminent man.

Q. Yes, in what line?

A. In water supply and sewerage.

Q. Do you know Mr. Edlow W. Harrison?

A. I have not had the pleasure of Mr. Harrison's acquaintance personally.

Q. Do you know him?

A. I know of him.

Q. What is his reputation, if you know it?

A. I regarded him and heard him spoken of as a very eminent and accomplished gentleman.

Q. Then your difficulty is that you don't agree with these gentleman?

A. Don't agree with them.

Q. And therefore it is purely a question of difference of opinion, is it not?

A. Yes, sir.

Q. Now, you said that there was no necessity to take the chances by discharging this effluent into New York Bay. Why is there no necessity for that?

A. Because if it is unobjectionable, it might just as well be discharged into Newark Bay.

Q. Yes, but you have got a condition in there. You say there is no necessity; well, why is there no necessity?

A. There is no necessity if they complied with that stipulation,

Q. You wish to qualify it with that condition. I understood you to say there was no necessity of taking the chance?

A. Of taking the chance, yes.

Q. Yes. Now, why is there no necessity?

A. Because if it is an unobjectionable effluent, well clarified
3909 and odorless, there is no objection to discharging it into Newark Bay.

Q. Well, now, isn't it possible to produce such an effluent?

A. Yes, sir.

Q. As a matter of fact by introducing to this system some devices or processes which you have patented, the thing can be done, can't it?

A. All my patents have expired.

Q. Well, I say——

A. Some of the things—there are various ways that it could be done.

Q. It could be done in a number of different ways?

A. Yes.

Q. And then the effluent in your judgment could be safely discharged into Newark Bay?

A. Yes, sir, or into New York Bay.

Q. And there would be no necessity of discharging it into New York Bay. These methods and processes are feasible?

A. Yes, sir, but very expensive.

Q. Well, you would not advocate the continuous discharge of the sewage into the Passaic River, would you; you would not recommend that?

A. No, sir.

Q. Nor in its crude state into Newark Bay, you would not recommend that?

A. No, sir.

Q. Well, what would you do with it, then?

A. I would purify it so that there would be no objection to its discharge in either one.

Q. Without regard to expense?

A. Without regard to expense.

Q. Well, now, turn again to Complainants' Exhibit No. 135 to which your attention has been drawn, I read the second section to you in these words—that the Passaic Valley Sewerage Commissioners further agree with the United States that in the operation of said sewer system at all times the following results shall be secured either through compliance with the requirements of the immediately preceeding paragraphs, or other requisite, lawful additional arrangement. Then, if those guaranteed results are obtained in either of those ways, in your judgment there will be no nuisance in New York Bay?

3910 A. No, sir, not if that was complied with.

Redirect examination by Mr. O'Sullivan:

Q. Drawing your attention, Mr. Powers, to the latter sentence that has just been read to you (reading) "or other requisite, lawful additional arrangement", what do you understand by that?

Mr. Riker: Well now, I object to the question being put to this witness on the ground that the interpretation of a written instrument is with the Court and not with the witness.

Mr. O'Sullivan: The question is pressed for the reason that he has just answered a question in which my quotation has been embodied, and with a view to determining whether the witness fully apprehends the importance and value of the question put to him.

The Commissioner: Note the objection of Counsel for Defendants.

The Witness: I would understand from that that any further treatment required would have to be made regardless of the expense.

Q. And how with reference to the lawful character of these additional requisite arrangements?

A. Well, that, of course would be a legal question and I am not qualified—that is, as a lawyer. Of course, if it were possible to raise the money, that would be another thing.

3911 Q. In your answer to Mr. Riker, Mr. Powers, did you contemplate interpreting judicially the sentence that I have quoted to you in my question?

A. Judicially? No, sir.

Q. Directing your attention again to Complainants' Exhibit No. 135, I ask you as a sewage expert if the plant described in that stipulation will produce the effluent and the results guaranteed in that stipulation?

A. In my opinion it will not. The further treatment will be required.

Q. Would it be an expensive process that would produce such results as are stipulated for in Complainants' Exhibit No. 135?

A. Yes, sir.

Q. If the effluent stipulated for or the results guaranteed in the Complainants' Exhibit No. 125 were produced, would there be any objection to its discharge into Newark Bay?

A. None whatever. It would be a benefit to the Bay.

Q. You were asked if you knew Mr. Rudolph Hering and Mr. George W. Fuller, do you know whether they are now alive and in health?

A. I have not met Mr. Hering in many years, but I have met Mr. Fuller in other cases, within recent years.

Q. You were asked as to the hydraulic pressure probable in sending the effluent through this long tunnel from the Newark Meadows to Newark Bay and under the Bayonne Peninsula and to Robbins Reef. Are you familiar with pumping devices?

A. Yes, sir.

Q. What types of power pumps or pump would be necessary to send it that distance?

A. Well, it would be absolutely necessary to use centrifugal

pumps, because the quantity is so large that piston pumps would be out of all proportion; they would have to be built in batteries.

3912 Q. And would a very great degree of force be necessary to send that effluent that distance?

A. No, only the difference between the hydraulic mean: you see the tide level would be the same at Newark Bay or slightly different, about an hour at the point of discharge at Robbins Reef. Now, of course, the hydraulic piston which would cause the discharge or issuance of that at Robbins Reef would simply have the head above that level, which is shown here as No. 100, described as 37 feet above the invert of the sewer and as the sewer is 26 it would make about 11 feet above the surface level or the tide level.

Mr. O'Sullivan: That is all.

Adjourned to May 20, 1913 at 10:30 A. M.

3913 Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COM-
MISSIONERS, Defendants.

NEW YORK CITY, May 20th, 1913.

Before James D. Maher, Esq., Commissioner.

Appearances:

W. J. O'Sullivan, Esq., Special Counsel for the People of the State of New York, Complainants.

Adrian S. Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

GEORGE A. SOPER, a witness in behalf of the Complainant, recalled, in rebuttal, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Dr. Soper, since you were on the witness stand, before, has the Commission, of which you are President continued its work of investigation and of suggesting remedies for the conditions to which you testified previously, and if so, state what work?

Mr. Riker: Now, I object to the question on the ground it is not rebuttal of any evidence offered on behalf of the defendant, the rebuttal being properly directed to the specific testimony of the defense, and not to the general line of the defense.

3914

The Commissioner: Note the objection of Counsel for the defendant.

Mr. O'Sullivan: You may proceed, Doctor?

The Witness: It has. The Commission has been continually at work, especially in preparing preliminary plans and estimates for such works of main drainage and sewage disposal as its previous studies had indicated were necessary and sufficient for the protection of the Harbor. At the same time the Commission has been making some analytical experimental studies into various questions. A large part of the planning has been published in a series of preliminary reports, of which two or three have already been put in evidence, I think, by me. Underlying these plans and estimates, as announced, there is a large amount of engineering work. For example, in one of the four divisions into which the Commission has separated the City of New York for purposes of studying, there were eight or ten alternate projects of plans made, the object being to develop the one that was most suitable for the locality.

Upon the Commission arriving at an opinion that it had worked out a plan and arrived at an estimate of cost which was suitable for the situation studied, the Commission has issued a report on that plan. That report has been termed preliminary because until the Commission's work of making such plans and estimates as were required of it for the whole of New York, it would not be safe in the Commission's opinion to call any of its plans final. In 3915 short, it would be necessary, when plans were made for each one of the divisions, to coordinate those plans in a better way than would be possible as the work progressed. Proceeding in the manner that I have mentioned, the Commission has issued preliminary report No. 4 to cover the collection and disposal of the sewage of the upper East River, and Harlem Division. The date of that report was July, 1912, and I have a copy here which was certified by the executive secretary to the Mayor, James Matthews.

Mr. O'Sullivan: I offer that report in evidence and ask that it be marked Complainants' exhibit No. 200.

Mr. Riker: The offer is objected to on the ground that it is incompetent, immaterial and irrelevant; and not properly proved.

The Commissioner: Note the objection of counsel for defendant.

Received in evidence and marked Complainant's Exhibit No. 200.

The Witness: I have here preliminary report No. 5, termed "Study of the collection and disposal of the sewage of the Richmond Division." It is dated September, 1912, and has been certified in the Mayor's office.

Mr. O'Sullivan: I offer that report in evidence and ask that it be marked Complainants' exhibit No. 201.

Mr. Riker: The same objection as to the last offer.

Received in evidence and marked Complainants' exhibit No. 201.

The Witness: I have here preliminary report No. 6, termed

3916 "Study of the collection and disposal of the sewage of the lower Hudson, Lower East River, and the Bay Division. It is dated February, 1913. It has been certified in the Mayor's office by the Mayor's executive secretary.

Mr. O'Sullivan: I offer that report in evidence, and ask that it be marked Complainants' exhibit No. 202.

Mr. Riker: Same objection as to the last exhibit.

Received in evidence and marked Complainants' exhibit No. 202.

The Witness: Each one of these preliminary reports contains the following statements on the title cover: "This report is issued in advance of the final report of the Metropolitan Sewerage Commission in order that the contents may be of early service. Some features of this report will remain open for revision until the final report is submitted." Before these reports have been issued, the officers of the City charged with the construction of the local sewers, chief engineers of the sewer bureaus specifically, have been invited to come to the Commission's office and criticise the work done and to offer the Commission the benefit of such practical suggestions for the improvement of these plans as they could make, it has been after receiving such criticism that the foregoing reports have been made.

When the Commission had arrived at an opinion as to the character of the works required for the lower Hudson, Lower East River, and Bay Division, it seemed desirable to obtain the best construction which could be obtained, not only from city officers, but from 3917 noted experts in sewage disposal. In order to obtain the best and most unprejudiced criticism, the Commission sent to England and obtained the services of two experts, one a chemist and one an engineer, and in preliminary report No. 7 are contained the reports, the critical reports of Messrs. Fowler and Watson, on the projects of the Metropolitan Sewerage Commission.

Q. Of New York?

A. Of New York, with special reference to the plans proposed for the Lower Hudson, also Lower East River and Bay Division. This report is dated February 1913. I have a copy here which has been certified at the Mayor's office by the executive secretary to the Mayor.

Mr. O'Sullivan: I offer that in evidence, and ask that it be marked Complainants' exhibit No. 203.

Mr. Riker: The offer is objected to on the ground that it is not rebuttal, it is immaterial, incompetent and irrelevant; the matter is hearsay, and that the report is not properly proved.

The Commissioner: Note the objection of Counsel for the defendant.

Received in evidence and marked Complainants' exhibit No. 203.

Q. By whom were these reports prepared, Doctor?

A. The reports of Fowler and Watson, you mean? Are those the reports which you refer to or the other?

Q. Those that I have just put in evidence now, Complainants'

exhibit- Nos. 200, 201, 202, 203. State how they were compiled, by whom?

A. Excepting Preliminary Report No. 7, which is No. 203 of the exhibits, the Preliminary Reports have been prepared by the Metropolitan Sewerage Commission of New York, the drafting of the report being done in the first instance by the President of the
3918 Commission.

Q. Who is the President of that Commission?

A. I am the President and Executive Member of the Commission, through whom all the scientific and technical work has been done. The draft so prepared has been transmitted to each member of the Commission, and after study on their part and discussion, the report has gone to revision and finally when satisfactory to all the members of the Commission, it has been printed. Preliminary Report No. 7, which is Complainants' exhibit No. 203, consists of two parts: The first part is a brief introduction to the second part; the first part, the introduction, was prepared as I have described for the other preliminary reports. The second part consists of two reports, one by Dr. Gilbert J. Fowler, of Manchester, England, and the other by Mr. John G. Watson, of Birmingham, England. The report of Gilbert J. Fowler was received by me as President of the Sewerage Commission. It was put into type under my immediate direction. The report of John G. Watson was received and printed under the same circumstances.

In preparing these reports, Messrs. Fowler and Watson were invited by the Sewerage Commission to come to New York and make such studies of the local situation as would enable them to teach from first-hand knowledge of the Conditions which could be observed. They came separately. Dr. Fowler arrived first and spent about two weeks in New York. When he arrived, he was expected to have a knowledge of the Commission's reports of data, and at the end of Dr. Fowler's visit Mr. Watson arrived. He made his studies, as Dr. Fowler had, and with a knowledge of the Commission's work as contained in reports. The studies on the ground were made separately by these experts, excepting for two or three days
3919 when their visits unexpectedly overlapped. Two months after the return of the experts to England, their reports were made.

Q. And are embodied in Complainants' exhibit No. 203?

A. And are contained in Complainants' Exhibit No. 203.

Q. Since you were on the stand last, Dr. Soper, has the Metropolitan Sewerage Commission continued analyses of the waters in order to determine whether or not material changes had taken place subsequent to the analytical surveys made in 1911 and to which you testified?

Mr. Riker: The question is objected to on the ground that it is not rebuttal of any evidence introduced on behalf of the defendant, and is immaterial and irrelevant.

The Commissioner: Note the objection of Counsel for the defendant.

The Witness: Yes.

Q. What analyses were made by the Commission?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

The Witness: Analyses reported in the large bound volume which the Commission issued in August 1912, report the analytical data collected to November 1911. From November 24, 1911, to April 5, 1913, the following analytical work has been performed: Dissolved oxygen in the Harbor water—

Mr. Riker: Well, one moment. I object to the testimony unless it appears that it has been done by this witness. It has not yet appeared. He says it has been done, I do not know whether he has done it or not.

3920 Q. Under whose direction, Dr. Soper, was this analytical work done?

A. Under my direction.

Mr. Riker: Is this responsive to any question?

Mr. O'Sullivan: I asked in relation to the analyses made by the Commission. Will you read my question?

The stenographer thereupon read the question.

Mr. Riker: That calls for yes or no.

Mr. O'Sullivan: Add to my question: "If so, state what analyses were made."

Mr. Riker: Additional objection is now made to the question as propounded that it calls for an answer within the knowledge of this witness, things that he has done himself.

The Commissioner: Note the objections of Counsel for the defendant.

The Witness: Dissolved oxygen in the Harbor water, 395 analyses; dissolved oxygen in incubated Harbor water, 219 analyses; salinometer tests with dissolved oxygen 395 analyses; tests for the best alkali to use for the dissolved oxygen analyses, 38; example experiments to determine whether sea water merely saturated with oxygen can be entirely saturated by shaking, four; dissolved oxygen in storm water, 1; cause of supersaturation of oxygen in water—this was an experiment dealing largely with the effect of temperature on saturation—20; rate of absorption of oxygen by water lying exposed to the air, 130; loss of oxygen in mixtures of sewage and sea water on standing for various periods of time, 24; effect of sludge on the amount of oxygen present in the overlying
3921 water, 7; loss of oxygen in unpolluted sea water on standing, 2; fermentation of Harbor water in Winter to determine whether fermentation takes place at ordinary water temperatures in the Winter season, 6;

Viability of bacteria in sewage and water, 80; viability of typhoid germs in water, 167 experiments; viability of typhoid in urine, 39; viability of typhoid in shellfish, notably oysters and clams, 93 tests;

uranine or tests of the movements of sewage—the tests carried on by means of dye called uranine 3; the total number of tests carried on in the group of researches just referred to was 1,613.

Passing now to another group—tests for albuminoid ammonia in the Harbor water, 200; tests for free ammonia in the Harbor water, 200; tests—and by tests I mean determinations of the amount of in all of these cases that I am now dealing with—nitrates, 223; tests of nitrites, 241; of salinity, 110; turbidity 80; color 110; dissolved oxygen 100. These tests mentioned in the last group have all been made on Harbor water.

Q. New York Harbor water?

A. New York Harbor water, soon after the samples were collected. There were determinations as follows for New York Harbor water after incubation:

Albuminoid ammonia, 152; free ammonia, 172; nitrates, 142; nitrites, 142; direct nesslerization of Harbor water, 10; determinations of dissolved oxygen in sewage 13; oxygen consumed in sewage 13; albuminoid ammonia in sewage, 13; nitrates in sewage 14; chlorine in sewage, 13; solids in sewage 26; determinations of numbers of bacteria in sea water, public water supply of New York, and Harbor water, 217; tests upon the purification of sea water by coagulation—

3922 Q. Is that sea water or sewage, Doctor?

A. Sea water and sewage, mixtures of the two. In connection with these experiments that I now mention, I had to do with studies of the Commission into the possibilities of using sea water to purify sewage, the idea being that there was a great deal of salt of various kinds in the sea water which might perhaps be turned to advantage in purification of the sewage before the sewage should be discharged. It was noted that when ordinary toilet and other washing soaps were discharged into the sea water and mixtures thereof a coagulation occurred and it was thought perhaps that coagulation might be turned to advantage in some method for the economical treatment of the sewage of New York City. 46 experiments were made with soap and sewage and sea water. It was then considered that these studies should be carried on with some of the ingredients of the soap; 71 experiments were made in this direction. The Commission then undertook experiments on the treatment of sewage by the aid of mixtures of sea water treated electrolytically for decomposition of the salts in the sea water. There were 130 experiments of this kind. Tests were made for the amount of carbon dioxide, 302, in Harbor water; there were 10 of these tests. There were 20 tests for various gases, not only carbon dioxide, but other gases in the Harbor water, the method in this case being to boil out the gases from the water and to determine the gases quantitatively by volumetric methods.

Q. Will you name some of those gases besides the carbon-dioxide, Doctor?

3923 A. Oxygen was one, methane another, sulphuretted hydrogen, hydrogen and nitrogen were gases to which interest attached. Experiments to the number of tests were made upon the pos-

abilities of using aluminium sulphate in the purification of the sewage. 30 determinations were made of the temperature of the sludge found on the Harbor bottom under different circumstances which occurred. There were 65 tests made to determine the rate at which sewage sludge absorbs oxygen from the Harbor water. There were 6 tests of the volume of gas found when sludge decomposes. There were 25 tests of the effect of bleaching powder as an oxidizing agent in treating the sewage. The effect of liquid chlorine as an oxidizing agent was examined in 40 experiments. There were 42 sets of samples of Harbor water to show the effect of freshet stages in the Hudson River, as far as those stages could affect the water in the East River, the belief being that Hudson River water flowed into the East River, and it being desired to ascertain some of the consequences. There were 40 tests made to show how sewage spreads out on the surface of the water of the upper East River, when discharged from the sewer outlets which there exist. The total number of tests referred to in this second group is 2,748.

The foregoing represents a brief outline of the analytical work, particularly the object and number of tests made since October and November, 1911.

Q. Has the Commission, the Metropolitan Sewerage Commission of New York, drawn any inferences from the data which you have just now testified to in relation to the assimilable qualities of the water of New York harbor for the digestion of sewage, and assimilation?

Mr. Riker: Same objection as to the preceding question.

The Commissioner: Note the objection of Counsel for the defendant.

The Witness: It has.

3924 Q. Will you state what those inferences are, Doctor, that have been drawn by the Commission, as to whether or not the waters have deteriorated or improved in that respect.

Mr. Riker: The question is objected to as not calling for any evidence on the part of this witness or even as to his own opinion, but to state the inferences of a body of which he is simply a member; and also on ground that it is incompetent irrelevant and immaterial, and not rebuttal of any testimony offered on behalf of the defendants.

The Commissioner: Note the objection of Counsel for the defendant.

Mr. O'Sullivan: You may proceed, Doctor.

The Witness: What is the question, please?

The stenographer thereupon read the question.

The Witness: The opinion of the Commission is that the waters have deteriorated. In some analyses of the water of the Lower East River for dissolved oxygen the Commission has found a smaller percentage of saturation than had formerly been observed. The average of a series of examinations indicated that the water of the Lower East River in the vicinity of the Brooklyn Bridge had fallen to 43 per cent of its saturation value of dissolved oxygen. Included in

this figure 43 are the results of a series of analyses made across the stream and at various depths.

Q. Did you complete your answer, Doctor?

A. That is the answer which I supposed would meet the requirements of your question.

Q. You mentioned or testified in regard to these incubation tests. What do you infer from these?

3925 Mr. Riker: The objection to that is that it is not rebuttal of any testimony offered by the defense.

The Commissioner: Note the objection.

The Witness: An inference drawn from the incubation tests was that the amount of oxygen found in Harbor water when the samples was collected, and analyzed at that moment, did not indicate the total draft upon the oxygen which the sewage present in the water would make. On standing and giving the sewage opportunity to act over a period of time more oxygen would be taken from the water.

Q. Is it usual to test waters for stability by incubation, and state whether or not it is adopted in other countries than this country.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

The Witness: It is usual and is regarded in other countries, particularly in England as a desirable procedure.

Q. One of the witnesses for the defense, Dr. Soper, referred to diffusion experiments which appear on pages 457, 458, 459 and 460 of Complainants' exhibit No. 134, being the report of the Metropolitan Sewerage Commission of New York, 1910. I ask if you have any details as to experiments set forth on the pages that I have just enumerated, in addition to the details that appear on the pages which I have indicated, and if so, state those details?

Mr. Riker: The question is objected to on the ground that it is irrelevant and immaterial, and is not rebuttal of the testimony of the defendants, but deals with other facts not under consideration by the defendants' witnesses.

3926 The Commissioner: Note the objection.

The Witness: I have some further details other than those stated on pages of the report referred to.

Q. The details which I am most particular about, are the strength of the dye solutions employed in these diffusion experiments the direction of the currents, salinity of the water, and the intensity of the currents, and also the temperature of the water?

A. Do you wish me to make a statement of the data that I have here in regard to that?

Q. Yes sir?

A. The experiments to which I will refer relate to the year 1909 and to the location of a proposed point of outlet of the Passaic Valley Sewer. The experiments extend through the months of June, July, August and October. On June 15th—I should say in regard

to the location at which these experiments were made, in some cases the experiments were made as close to the proposed site of outfall as could be determined from the report of the Passaic Valley Sewerage Commissioners of 1908. In some cases other points in the vicinity were chosen. On June 15th, at a point 250 feet east of Robbins Reef bell buoy one pound of uranine dissolved in 425 gallons of water, making a preparation of one part dye to 2,750 parts water was released. The temperature of the water was 66 degrees fahrenheit; the current was flowing ebb, and the salinity was 1.0115.

Aug. 3. High tide, 9.00 a. m. Ebb, 70 1,050 gals. 1.284 1.000 1.020 71

NOTES.—10.44 a. m. Began pumping dye water at depth of 20'.
 10.52 a. m. Raised discharge end of hose to 25'.
 10.59 a. m. Stopped pumping.
 11.14 a. m. Resumed pumping at depth of 20'.
 11.16 a. m. Stopped pumping.
 11.29 a. m. Resumed pumping at depth of 25'.
 11.39 a. m. Color seen 100' from boat and another field four from boat.
 11.33 a. m. Resumed pumping at depth of 20'.
 11.44 a. m. Color seen 500' distant on right hand 400' to left.
 11.54 a. m. Color seen 1200' beyond Fort Hamilton.

Aug. 5. High tide, 10.40 a. m. Ebb, 70 000 gals. 1.500 1.000 1.020 70

NOTES.—Specific gravity of Harbor water-surface, 1.010.
 " " " " " 20' deep, 1.020.
 " " " " " 40' deep, 1.020.
 12.35 p. m. Began Pumping at depth of 20'.
 12.40 p. m. Color appeared 45' from boat.
 12.42 p. m. Resumed pumping at depth of 25'.
 12.55 p. m. Color appeared 800' from boat.
 1.02 p. m. Resumed pumping at 40' deep.
 1.20 p. m. Color seen 400' toward Hudson River.

Aug. 6. High tide, 11.34 a. m. Flood, 4 1,000 gals. 1.500 1.000 1.010 70

NOTES.—Specific gravity at surface of Harbor Water, 1.018¹/₂.
 " " " 20' deep, 1.019¹/₂.
 " " " 40' deep, 1.020.
 1.01 p. m. Began pumping at 40' deep.
 1.15 p. m. Stopped pumping.
 1.32 p. m. Resumed pumping at 35' deep.
 1.48 p. m. Raised discharge to 20' deep.
 1.54 p. m. Franchise appeared 300' away.

3329 Date, 1909.	Stage of water Gows. Is.	Tide.	Current.	Velocity.	Lbs.	Uranine.		Specif. grav.		Temperature— Degree F.	
						Dilution water, gals.	Pro- por- tion.	Dye liq.	Harbor water.	Dye liq.	Harbor water.
Aug. 13.	Low tide, 12.17 p. m.	Flood..	Flood..	1' per sec...	5	300 gals.	1/500	1.000	1.017	63	72
<p>Notes.—Specific gravity of Harbor Water surface.....1.016½. " " " " 20' .....1.017. " " " " 40' .....1.017½. 3.15 p. m. Began pumping at depth of 40'. 3.26 p. m. Pumping at depth of 25'. 3.28 p. m. Stopped pumping. 3.35 p. m. Color appeared 400' from boat. Surface velocity, ¼' per second.</p>											
Aug. 4.	High tide, 9.15 a. m.	Ebb....	Ebb....	.....	20	700 gals.	1/250	1.000	1.020	70	70
<p>Notes.—Color discharged at depth of 30'. No uranine was discovered on the surface. Owing to bad light, rain, and rough surface of water the color would have been difficult to detect.</p>											
Aug. 11.	High tide, 4.35 p. m.	Flood..	Flood..	2' per sec...	..	.....	1/2000	1.000	1.019	71	73
<p>Notes.—Specific Gravity of Harbor Water Surface.....1.018. " " " " 20' .....1.019. " " " " 40' .....1.019½. Color discharged at depth of 35'. No color due to uranine was noted.</p>											
Aug. 18.	High tide, 9.44 a. m.	Ebb....	Ebb....	1' per sec...	..	.....	1/1000	1.000	1.019	63	69
<p>Notes.—Specific Gravity of Harbor water surface.....1.019. " " " " 20' .....1.019½. " " " " 40' .....1.019½. Color discharged at depth of 30'. No color was noted.</p>											
Aug. 26.	Low tide, 9.12 a. m.	Flood..	Flood..	3' per sec...	200	62,450 gals.	1/1780	1.003	1.016	65	72

3930 Notes:

Special Gravity at surface.....	1.015
“ “ “ 20’	1.016
“ “ “ 40’	1.017

Color discharged from 8" discharge pipe at a rate of 14.8 feet per second, at depths varying from 44 feet at start to 36' at end of pumping period. No color was noted at the surface owing probably to the fact that the higher rate of discharge diffused the dye through a very large volume of sea water, thereby diluting it so that it could not be distinguished at the surface.

Q. What inference did you, Doctor, draw from these dye experiments to determine questions relating to diffusion and dispersion?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

The Witness: That sewage discharged at the same points and same stages of tide might rise to the surface of the water before becoming greatly diluted. A great many inferences and opinions were drawn from all of this experimental work, but as I understand it you care more for the things that impressed the Commission as essential and of chief importance than the minor considerations?

Q. Yes, sir. Would large volumes of sewage amounting to 360,000,000 gallons a day be more or less likely to appear at the surface than the dyes that you used in the strengths that you used in these diffusion experiments?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

The Witness: More likely.

Mr. O'Sullivan: Your witness, sir.

Mr. Riker: No questions, sir.

Adjourned to Wednesday May 28th, 1913 at 10:30 A. M.

3931 Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COM-
MISSIONERS, Defendants.

Before James D. Maher, Esq., Commissioner.

NEW YORK CITY, May 28th, 1913—10:30 a. m.

Appearances:

William J. O'Sullivan, Esq., Special Counsel for the People of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

SAMUEL A. GREELEY a witness called in behalf of the Complainants in rebuttal, being first duly sworn, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Mr. Greeley?

A. Samuel A. Greeley.

Q. Where do you reside, Mr. Greeley?

A. At Winnetka, Illinois.

Q. What is your profession?

A. I am a Sanitary Engineer.

Q. What is your present occupation?

A. I am an Assistant Engineer with the Sanitary District of Chicago.

Q. Where did you receive your professional training?

3932 State in full and what degrees you have received and where you received your technical training?

A. I received a scientific education, having special reference to sanitary engineering. I graduated at Harvard University in 1903, receiving the degree of A. B. I spent portions of the following three years studying sanitary engineering at the Massachusetts Institute of Technology, graduating with the degree of Bachelor of Science.

Q. When did you become actively engaged in the practice and practical duties of your profession?

A. I became actively engaged in the practical duties of my profession in June 1905. From then until May, 1908, I was engaged as assistant engineer with the firm of Hering & Fuller of New York City. During this time I worked in various capacities on the design and construction of works for the disposal of sewage and refuse and the purification of water.

Q. State some of the projects that you were connected with during that period?

A. Among the projects with which I was connected during this period the following may be mentioned: At Columbia, Pennsylvania, I served as resident engineer on the construction of a dam and reservoir for the water supply of the city. At York, Pennsylvania, I served at various times as assistant engineer on the construction of sanitary sewers and made special investigations for the protection of certain lands along the river from damages due to floods. In September, 1906, I took up a position in the New York office of the firm of Hering & Fuller and worked on the detailed plans for sewage disposal works at York, Pennsylvania; Reading, Pennsylvania; Allentown, Pennsylvania; Togus, Maine; the Montefiori Tuberculosis Sanitarium in New York; and at Madison New Jersey. I was connected with water purification plants at Bangor, Maine, and Burlington, Vermont, and with the investigation for additional water supply at Bellingham, Washington. The work at Bellingham, Washington, included a special trip to Bellingham for the purpose of going over the local situation with the city officials and completing the work necessary for a final report.

3933 During this period I worked on the engineering features of the design of the Passaic Valley trunk sewer. I also worked for a period of three months in the Department of Water Supply, Gas and Electricity of the City of New York, on the design of a sewage disposal plant for Mount Kisco, New York. I was further engaged on the valuations of the water works of the Monongahela Water Company and the water works of Cortland, New York. During the Winter and Spring of 1908 I worked up in detail the plans and specifications for the refuse incineration plant for Milwaukee, Wisconsin. In May, 1908, I went abroad, traveling through Germany, France and England, making a study of works for the filtration of water and the disposal of sewage and refuse in the larger cities of these countries. This trip lasted until August, 1908. In Germany I inspected the sewage disposal works at Hamburg and Frankfort, and at other places.

Returning to New York about the first of September, 1908, I resumed my place in the office of Hering & Fuller, working first on the design of a sewage system and sewage disposal plant for Batavia, New York. I worked up in detail plans and specifications for refuse disposal at El Paso, Texas, and did additional work on the refuse disposal scheme at Milwaukee, Wisconsin.

In March, 1909, I went to Milwaukee as Resident Engineer where I had charge of the construction of a refuse incineration plant for the city. I completed the construction of this plant in May, 1910, and in June following took charge of the plant as superintendent for the City. I continued as superintendent until August, 1911, when I again went to Germany. The purpose of this trip was to secure, in particular, data relative to the collection of refuse, in order to better operate the collection service in Milwaukee. I also was particularly requested to inspect the sewerage works at Hamberg, Dresden, Frankfort and Essen, in order to secure data that would be helpful in carrying out a project for sewage disposal in Milwaukee recommended by a commission made up of Mr. Eddy of Boston, Mr. Whipple of New York, and

Mr. Alvord of Chicago. I returned from this trip late in September and for a few weeks resumed my position in Milwaukee as superintendent of the refuse disposal works.

In October, 1911, I accompanied Mr. James H. Fuertes of New York to Caracas, Venezuela, to assist in the preparation of a report upon the water supply, sewerage and sewage disposal for that city. Mr. Fuertes left me in Caracas in charge of the investigations. I returned from Caracas in December, 1911, and prepared a report on the work for Mr. Fuertes.

In February, 1912, I became associated with the Sanitary District of Chicago as assistant engineer in the sewage disposal division of the Engineering Department. My work in this position has included investigations, reports and designs for sewage disposal in the vicinity of Chicago. In particular, I made detailed reports upon the disposal of the sewage in the so-called "Calumet" district in Indiana, and upon the sewerage and sewage disposal of the northern part of the Sanitary District. During the Summer of 1912 I prepared plans and built a sewage testing station for the packing house district of Chicago. I have also had immediate charge, under the Division Engineer, of the preparation of plans for a settling plant project for a district of approximately 25,000 people on the west side of Chicago. One of the chief features of my work with the Sanitary District has been the design and general supervision of the construction of numerous settling tanks for the treatment of trade wastes from individual factories.

Before my association with the Sanitary District of Chicago I had undertaken a certain amount of consulting work which it has been necessary for me to continue. I am at the present time serving as consulting engineer on refuse disposal to the Commissioner of Public Works of Detroit, Michigan. I am also acting with the city engineers of Winnetka, Illinois, and Lake Forest, Illinois, as consulting engineer on sewerage and sewage disposal work.

I have throughout the Winter consulted with Mayor Bading of Milwaukee on preliminary work relating to the necessary legislation for the formation of a sewerage commission for that city.

During the winter of 1912 I have given special lectures at the University of Illinois, Medical School, and at the University of Chicago, upon the subject of refuse disposal.

I have from time to time published numerous papers relative to refuse disposal and sewerage matters. My work with the Sanitary District has given me particular opportunity to measure the flow in sewers and the rainfall on the sewerage districts, and I have reported the results of this work in a paper before the Western Society of Engineers.

Q. Mr. Greeley, have you examined the testimony given in this case by Mr. William H. Brown, Chief Engineer of the Passaic Valley Sewerage Commissioners?

A. I have, in a general way.

Q. Have you had any connection with the sewage disposal of Boston, which Mr. Brown speaks of in his testimony?

A. Yes. During the Winter of 1905 I started an investigation of

the composition of Boston sewage and its disposal and dispersion in Boston Harbor. This work was undertaken as thesis work in conjunction with Mr. Charles Saville.

Q. Did you complete this work?

A. No. The work was only partly finished. We were making 24-hour tests upon the chemical composition of Boston sewage to ascertain the variation in the composition. During the second of these tests Mr. Saville and I both contracted typhoid fever of such a severe character that the work was necessarily closed without being completed.

During the time of these investigations, Mr. Saville and I were living together at a fraternity house with two other men, all of us eating the same food and drinking the same water, and of the men at this fraternity house we were the only two to take typhoid fever, and we came down with it, at approximately the incubation period, at the date of the test of the Boston sewage at Deer Island.

Q. Were any of these other men engaged outside of Mr. Saville and yourself in these tests you have described on the Boston Sewage?

A. No, we were the only two.

Q. Where were those tests conducted, Mr. Greeley?

A. One of the tests was at the Cow Pasture Pumping Station, and the other was at the Deer Island outlet.

Q. Have you examined the testimony given in this case by Mr. George A. Johnson?

A. Yes, I have.

Q. Did you find that on page 3959 of his testimony he stated that the field force under his direction, in connection with the chemical and bacteriological work done by him in the Fall of 1907 for the Passaic Valley Sewerage Commissioners, was in your charge?

A. Yes.

Q. What connection did you have with the work done by Hering & Fuller under Mr. Johnson's direction for the Passaic Valley Sewerage Commissioners? Was it in your charge?

A. No. My work related chiefly to engineering details required for the computation of the proper size and slope of the proposed trunk sewer. In this connection I made personal examinations and estimates of the distribution of population over the district tributary to the proposed trunk sewer, and assisted in the determination of the quantity of sewage which might enter the trunk sewer at various points along its length, so that the proper proportions could be determined. I had no connection with the chemical and bacteriological work done at this time.

Q. Have you read Mr. Johnson's testimony, given on pages 4040, 4041 and 4048?

A. Yes.

Q. With reference to sewage screens and their efficiency?

A. Yes.

Q. In this part of his testimony Mr. Johnson states on page 4040: "The amount of suspended matter removed by screens will vary from

15 to 50 per cent. of the total suspended matter contained
3937 in the sewage. The screens that I have referred to as removing 50 per cent. of the suspended matter are of the type used in Dresden where the sewage, after passing through the grit chamber, is passed through a disk screen which is about 5 feet in diameter and has openings about $1/12$ of an inch in the clear." I direct your attention to page 4041 of Mr. Johnson's testimony given in this suit. He states: "I have figured that about 20 per cent. as a maximum should be anticipated as the efficiency of these fine screens or screens having openings of $4/10$ of an inch." Mr. Johnson further stating in his testimony in this suit on page 4048: "I feel that in the screening device there will be removed suspended matters amounting to in round numbers 15 per cent. of the total suspended matters in the crude sewage." Mr. Johnson computing from data given in Doctor Dunbar's book, entitled "The Principles of Sewage Treatment," that the removal of suspended matter by screens of the type used in Hamburg, where the opening between the bars is approximately $4/10$ of an inch, would be 26.7 per cent. This he states, quoting his language, "is in excess of the figure I have just stated and is based on actual results with a screen of a type in general accord with the screen described in the stipulation."

Now, referring to Complainants' Exhibit 135, which I hand you, is the result of your knowledge and observations of sewage screens in actual operation in accord with these statements, to which I directed you and which have been testified to in this suit by Mr. George A. Johnson?

A. No, it is my observation that the removal of total suspended matter by screens of the types used at Hamburg and Dresden when applied to the Passaic Valley sewage will not be as great as 15 per cent., and will probably not exceed 10 per cent. as a maximum, and will probably average less than 10 per cent.

Q. On what do you base that statement?

A. I base my statement on the results of personal observations of the operation of the sewage screening plants at Hamburg, Dresden
and Frankfort, Germany, and on the data given to me by
3938 the men in charge of those plants as to the quantities removed, and on reports of tests made of the percentage removal of total suspended matter at these plants.

Q. Directing your attention again, Mr. Greeley, to the testimony given in this suit by Mr. Johnson, and particularly to page 4051 of his testimony, in answer to the question: "Could these works be operated on the Newark Meadows without giving rise to nuisance of offence of any kind?" he answered: "I believe that they could. basing my judgment on personal observation of sewage works in this country and abroad, in England especially, where such works as these are immediately alongside of public highways and close enough to toss a stone into, and in some cases residential sections of some class." Was your observation of the sewage screening plants in Germany in accord with this statement?

A. No; the handling of screenings removed by the screens from the sewage at the plants mentioned created a nuisance. I found dis-

ting odors similar to those from a pig-pen coming from the screenings stored at the Dresden plant and from the screenings which fell from the conveyors used to handle the screenings at Hamburg and Frankfort. The disposal of the screenings from the Hamburg screens upon the low lands, down stream from Hamburg, was particularly obnoxious.

Q. Directing your attention again to Mr. Johnson's testimony as given in this suit, and particularly to page 4156 of his testimony where Mr. Johnson is reported as stating "as a general rule the screens are about 15 feet in diameter and built circular." This statement refers to the Dresden screens. Did you find the screens at Dresden to have this diameter during your examination of them?

A. No; I found the diameter of the Dresden screens to be 8 meters or 26.24 feet.

Q. Was the Dresden plant in operation in 1908, the date of the publication of Dr. Dunbar's work entitled "Principles of Sewage Treatment" from which Mr. Johnson quoted during his testimony?

A. No.

Q. The screening plant at Dresden went into operation during the Winter of 1910 and 1911?

3939 Mr. Riker: The question is objected to as not being rebuttal.

The Commissioner: Note the objection of Counsel for Defendants.

Q. Will you describe more in detail the observations which you made of the sewage disposal works in Hamburg, Dresden and Frankfort, stating the year and the month when you made the observations and examinations?

A. I have here a report of the observations and visits which I made and from which I will read part. I proceeded first to Hamburg, Germany, where I spent August 30th and 31st and September 1st, 1911. Hamburg is a city of about one million inhabitants in Germany, on the River Elbe. The river divides the town into a larger northern section of about 850,000 people, and a smaller southern section of about 150,000 people. Near the center of the northern district is a larger lake or basin, called the Alster; and there are several small streams and canals throughout the city. The whole city is sewered on the combined system, and there are numerous overflows for storm water at various points throughout the city. The sewage of the northern district is all conducted to one main point of discharge into the Elbe river. The sewers leading to this point of discharge are large, smoothly built, well ventilated, and have good slopes, so that the sewage reaches the point of discharge in a fresh condition, without much odor. Herr Brunotte told me that the minimum velocity of flow in the system was 0.6 meters (1.97 ft.) per second, but that this minimum was confined to a few small sewers and that in the main trunk sewers the velocity of flow was about 1.0 meters (3.28 ft.) per second. He estimated that the time of flow for most of the sewage coming to the northern district point of discharge was from two to four hours, depending upon the volume of sewage flowing in the sewers.

The Elbe river, as it flows through Hamburg, is a tidal stream, the water being yellow-colored and turbid, with a fine "mucky" sort of suspended matter. Above the town it is used for the city water supply and is not strongly colored or turbid, but requires filtration to make it a clear, safe drinking water. The range of the tide is about 3 meters, 9.8 feet, but the stage of the water at Hamburg varies with the wind. The Sewage Screening plant of the 3940 northern district consists of coarse bar screens at the end of the main sewer and small grit chamber and revolving mechanical screens of the belt type. In this plant there is one grit chamber at the end of which are two screens. The bars of these screens are spaced 15 millimeters in the clear, and the screens are each 3.3 meters of 10.8 feet wide. The screens travel at the rate of about 2 meters or 6.56 feet per minute, and have only one speed of operation. The average quantity of sewage flowing through this plant is 190,000 cubic meters per 24 hours, equivalent to 50,000,000 gallons per day. The grit chamber is cleaned two or three times a week, the cleanings amounting to from 12 cubic meters or 15.7 cubic yards to 16 cubic meters or 20.9 cubic yards, daily, the average removal being 20 cubic meters or 26.1 cubic yards per day of wet screenings. The sludge and screenings are dumped into covered steel barges which are towed to the dumping grounds, several miles below the city. After the sewage passes through the screens, there are five discharge pipes through which it may pass into the river. Ordinarily only three of these are used; the other three, which extend into the river, 70 meters, 100 meters and 133 meters from shore respectively; and all are turned up 90 degrees at the end and discharge at the bottom of the river. A new screening plant serving the southern district of Hamburg has been built and is operating very much below capacity because the intercepting sewers had not yet been completed. I visited the two screening plants on August 30th, 1911 in company with Mr. Helmke an assistant of Dr. Brunotte's, in charge of sewage disposal. On August 31st, I again visited the old plant and then took a launch and spent the day on the river visiting the plants where the sludge and screenings were disposed of. On September 1st, 1911 I called on Dr. Brunotte again questioning him with reference to certain points about the disposal methods.

Q. Who is Dr. Brunotte?

A. Dr. Brunotte is the engineer in charge of sewage disposal in Hamburg. Referring to the visit made on August 30th, 1911, Mr. Helmke and I left Dr. Brunotte's office about 1:30 P. M. and proceeded by trolley, ferry and on foot to the new screening 3941 plant on the south side of the Elbe. The general appearance of the plant, as we approached it, was attractive and no sewage odor was noticeable until we had entered the grounds. From the new plant we went by the city's launch to the old plant, and on the way there was good opportunity to observe the Elbe water. This was in all places a yellowish brown, without many large floating matters. The river was very choppy and they say, always is, so that there is very little opportunity for sleek to collect on the surface. Here and there I saw blotches of it, about 12 inches in

diameter. As we came within 100 yards of the plant, there was noticeable a sewage odor. The buildings and grounds of this plant were also attractive. Entering the screen room, there was noticeable a sewage odor but not outside the plant. The sewage appeared fresh but did not smell strongly. The depth of sewage in the grit chamber, I measured to be 3 meters and it was flowing through at a good velocity. After inspecting the plant we went in the City launch to a point just over the outlets. Mr. Helmke pointed out the location by some floating matters and white froth or foam on the surface. There were sea gulls, although I had seen them nowhere else. On the day of my visit, it was cool and there was a good breeze blowing from just west of north. The river was very choppy. I could not see any marked evidences that sewage was being discharged into the river, except the gulls. On August 31st, 1911, I went first to the old plant and then took a launch with an English speaking engineer to visit the place called Newenfelde, where the screenings from the plants are disposed of. I have here some photographs which I took at Hamburg, illustrating the place of disposal of those screenings.

Q. Who took those photographs?

A. I took them.

Q. Where were they developed?

A. They were developed and printed in Hamburg. We reached Newenfelde, the place where the point of disposal of the screenings was, about noon, and had a two mile walk to where the tank boats from the sewage plants were unloaded. The country we walked through was wholly devoted to truck gardens and orchards, and the whole neighborhood smelled of the pig pen odor
3942 from the sewage screenings used as fertilizer. The unloading station is located on a small creek and was very foul. It consists of only an inlet for docking the tank boat, a derrick, some trucks and a narrow gauge, movable track. These are illustrated in the photographs. The derrick is used to lift the body of the truck from the frame to the boat. There it is filled with a shovel and then replaced on its frame, and the whole car is then run out onto the dump.

Well, going back from the point of disposal of screenings I observed carefully the Elbe water, taking samples about 6 inches below the surface in a bottle. These samples were colored a yellowish brown which did not increase on standing 24 hours. In each of them there was a fine mucky sediment. It had a slightly salty and fishy odor and contained a fine yellowish mucky suspended matter.

As a summary of the observations made during the three days at Hamburg, I would state that the discharge of effluent from the sewage screening plants of Hamburg into the Elbe did not add seriously to the turbid appearance of the water, the Elbe itself being a colored turbid water at that point. The absence of a discernable sewage field was due to the dispensing of the sewage in the water through the agency of the ships, tugs and tides which intersect the water at many angles and keep the water continuously churned up. There were evidence of sewage pollution, such as the

presence of gulls, the sleek near the docks and the floating particles. The greatest nuisance from the plants came from the handling of the sludge and screenings at the plant and from their ultimate disposal on land.

After visiting Hamburg I proceeded to Dresden, where I spent September 2nd, 1911. Dresden is also located on the Elbe River, the sewage disposal plant being located on the Elbe below the town. Dresden is sewered on the combined plan. There are two main intercepting sewers, one on each side of the river. The superintendent at the screening plant told me that the time of flow of sewage from the center of town to the disposal plant was only about one half hour, and the time of flow for most of the
3943 sewage did not exceed $2\frac{1}{4}$ hours from the point of entrance into the sewer to the disposal plant. The disposal plant where the sewage is screened, is located well below the town in open country, on a large tract of farm land owned by the city. The disposal works consist of coarse bar screens and main screen house in which are located four large disc screens, and a pumping station, and various other office buildings, and a house for the workmen. The main revolving mechanically cleaned screens are of the "Riensch" disc type and are each 8 meters or 26.24 feet in diameter. I have a plan and photograph of one of the screens here—a plan of the plant and a photograph of one of the screens. They revolve at two speeds, one revolution at 2 minutes and one revolution per 3 minutes. They are run generally at the lower speed. The slits through which the sewage passes are 2 millimeters or .078 inches wide on top, 3 millimeters or .117 inches wide on the bottom, and 30 millimeters, or 1.17 inches long. They are made of brass plates, 5 millimeters or .196 inches thick on the disc and 4 millimeters or .157 inches on the cone at the center of the disc. The maximum loss of head in going through a screen is 60 centimeters or 23.6 inches, or about 2 feet. The screens are cleaned by revolving brushes, which scour the screenings off the screen into a conveyor, which discharges them into small cars in which they are conveyed to the dumps in the yard.

I went to the Sewage Disposal Works by trolley along the south side of the river as far as Mohn street, which is the end of the line, where I walked along the river, then through a suburb, and finally through open fields, to the plant—a total walk of about $1\frac{1}{2}$ miles. I learned from Mr. Scheitzow—

Q. Who is Mr. Scheitzow?

A. The Superintendent of the plant. I learned from him that the quantities of material removed from the sewage at the disposal works were as follows: From the two grit chambers, one cubic meter or 1.3 cubic yards; from the scum boards and bar screens,
3944 one cubic meter, or 1.3 cubic yards, daily; from the revolving screens, 10, or 13.0 cubic yards, to 12 cubic meters, or 15.7 cubic yards, daily. Then I went through the plant with the superintendent. The material removed from the sewage is piled in the yard and either given away or sold as fertilizer. I walked from the plant down the river about one third of a mile to the sewer outlet and then about one mile further down to the ferry where I

crossed over to the north side of the river. The river water was dirty and dark appearing all the way down. From the sewer outlet to the ferry, I noticed a slight but distinct odor, and there were blotches of sleek evident on the surface. The summary of these observations is that the discharge of the effluent from the sewage screening plant into the Elbe increased the unpleasantness of the river water. There were evidences such as sleek which collected along the shore, and the floating particles and the sewage odor; that the greatest odor from the sewage treatment came from the storage and distribution of screenings.

Q. Now as to Frankfort.

Mr. Riker: One moment. I object to Frankfort on the ground that that is not rebuttal.

The Commissioner: Note the objection of Counsel for the Defendants to the question.

Q. Just summarize in as few words as you can, the observations at Frankfort, giving the size of the screen mesh and the resulting effluent and whatever it occasions?

Mr. Riker: The objection is renewed to the question as revised on the ground that it does not call for rebuttal testimony on any evidence of the defendants.

The Commissioner: Note the objection of Counsel for the Defendants.

A. At the plant at Frankfort there are three screens of the paddle wheel type, each screen being 2 meters wide and the clear
3945 spacing between the bars is 10 millimeters. The screens are cleaned mechanically. The quantity of screenings removed—

Q. 10 millimeters would be what in inches?

A. 0.39 inches. The screenings removed amount to 19.9—

Q. Can you give me that in the fraction of the inch?

A. It is somewhat less than $\frac{4}{10}$ ths. I inspected this plant on September 4th, 1911. The summary of the observations at this plant is that the discharge of the effluent from the sewage disposal works into the Main materially increased the insightliness of the water, and there were evidences of sewage pollution, such as the boiling or bubbling up of the sewage plant effluent in the river water and the clearly marked sewage area extending down stream from the point of discharge. The city, after disposing of the sludge and screenings on land for a number of years, had gone to great expense to dry and then burn the sludge and screenings from the sewage works.

I have in conjunction with these observations secured certain maps and descriptive pamphlets substantiating the observations and amplifying them, which are attached to the report as certain appendices listed and mentioned in the written part of the report.

Q. You may describe these appendices without using any words from the report.

Mr. Riker: If that is in the form of a question is it objected to as not being rebuttal, being immaterial and irrelevant and not the best evidence.

The Commissioner: Note the objection of Counsel for the defendants.

A. Appendix I is List of the Drawings and Documents secured. Appendix II is a Tide Table for Hamburg, setting forth the stage of the tide at the time of my visit there. Appendix III-A is a Descriptive Pamphlet with maps of the sewers and screening plant at Hamburg.

3946 Q. Where did you get that?

A. I got that from the Sewer Department in Hamburg; Appendix III-B is a description of the screens by the manufacturers and is a trade document published in Germany. Appendix IV is a Map of Hamburg, showing the course of the river to the city. Appendix V is a book which I bought in Hamburg, being a report on Investigations of the Elbe River at Hamburg and takes up the biological condition of the river as influenced by the sewage discharged into the river. Appendix VI is a Map of Dresden. Appendix VII is a description of the Sewage Purification plant and Sewage Screening Plant at Dresden given to me by the Superintendent of the plant. Appendix VIII is a map of Frankfurt; and Appendix IX is a description given to me by the Engineer in the City Hall in charge of Sewage Disposal, as a correct description of the sewage screening plant at Frankfurt.

Q. Mr. Greeley, directing your attention again to the testimony given by Mr. George A. Johnson on page 4040 from which I quote: "The amount of suspended matter removed by screens will vary from 15 to 50 per cent. of the total suspended matter contained in the sewage, through a disc screen which is about 5 feet in diameter in the clear." I ask you after directing your attention to that testimony, if any of these screens will remove that percentage of suspended matter?

A. No; it is my observation that the sewage screens at Dresden do not remove 15 per cent. or greater of the total suspended matter.

Q. How about Hamburg and Frankfurt?

A. The same is true of Hamburg and Frankfurt.

Q. Did you prepare a report on the observations that you have testified to and of the photographs that you took, that you say you had developed in Hamburg?

A. Yes, I have a report here which I prepared after returning from the trip.

Mr. O'Sullivan: I offer that report in evidence and ask that it be marked Complainants' Exhibit No. 204.

3947 Mr. Riker: The offer is objected to on the ground that the report is not evidence, that it is immaterial and irrelevant, and is not rebuttal, and that the contents of it is not relevant to the issue.

The Commissioner: Note the objection of Counsel for the defendants.

Received in evidence and marked Complainants' Exhibit No. 204.

Q. Mr. Greeley, what was the most distinctive feature of the sewage treated at the screening plants at Hamburg, Dresden and Frankfort, based on your observations and inquiries as it relates to the efficiency of screens of this type?

Mr. Riker: The question is objected to on the ground that it is not rebuttal of any evidence on behalf of the defense.

The Commissioner: Note the objection of Counsel for the Defendants.

A. I found the most important characteristic of these sewages to be their freshness.

The matter removed from the screens consisted largely of large pieces of fecal matter, unbroken up. The sewage was not dark-colored or septic in appearance and did not have the odor characteristic of old sewage.

Q. Did you make any effort to ascertain approximately the age of the sewage as it reached the plants at these cities, which I have just named?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes. I have made such inquiries and have recorded the results of the inquiries in this report, and have already referred to them.

Q. Complainants' Exhibit No. 204?

A. Complainants' Exhibit No. 204. The time of flow for most of the sewage coming from the screening plant at Hamburg was from two to four hours.

Q. Mr. Greeley, you stated that you found that the removal of total suspended matter in the sewages of the cities of Hamburg, Dresden and Frankfort by the screens was not in excess of 10 per cent. Upon what data do you base that statement?

A. I base it in particular upon the actual quantities removed as given to me by the Superintendents in charge of the plants and on the results of analyses contained in a report of the Sewerage Department of Frankfort, made to the Government upon the Pollution of the Main River dated 1908.

This report contains a summary of a number of experiments, chemical experiments, made by several collaborating chemists, whose names are placed on record in the report. It is stated on page 5 of that report that the total suspended matter—

Mr. Riker: I object to the reading of this report into the evidence, as not being properly proved, not being evidential, and not being rebuttal.

The Commissioner: Note the objection of Counsel for Defendants.

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The Witness (continuing): On page 5 of this report it is stated that the total suspended matter in the raw sewage amounts to 410 parts per million; that there is removed by the screens 21 parts per million. There is, therefore, a percentage removal of 5.12 per cent. I was unable to secure similar analytical data for the plants at Hamburg and Dresden.

Q. Can you give an estimate or approximation of the quantities of screenings removed each day from the reports furnished you by those in charge of the operating plants at the points that we have just been questioning about, at Hamburg, Dresden and Frankfort?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. Only upon the assumption that these wet screenings contained approximately a certain percentage of moisture.

Q. What percentage would your observations and inquiries indicate to you as being a reasonable minimum quantity of 3949 water or of moisture contained in the screenings?

Mr. Riker: The question is objected to on the same grounds, and also on the ground that the hypothesis upon which the question is based is not proven in this case.

The Commissioner: Note the objection of Counsel for the Defendants.

A. About 70 per cent.

Q. Assuming that the screenings removed in the quantities given you by those in charge of the plants at Hamburg, Dresden and Frankfort contained 70 per cent. of moisture, what is the percentage removal of total suspended matters by the screens at Hamburg and Dresden?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. I find that at Hamburg the screens removed suspended matter that amounted to 10.5 per cent. of the total suspended matter and at Dresden to about 11.2 per cent. of the total suspended matter.

Q. In your opinion are these percentages greater or less than the percentage that would be removed by screens having clear openings of about 4/10ths of an inch similar to those in operation at Hamburg and as proposed by the Passaic Valley Sewerage Commissioners?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I consider these percentages to be greater than the average to be expected.

Q. How do the screening plants at Hamburg and Dresden compare with other screening plants?

A. They are among the best screening plants in operation. They are very carefully and well operated. The plant at Dresden is one

of the best built that I have seen and they are good representatives of screening plants of their types.

Q. In your opinion would the sewage of the Passaic Valley trunk sewer contain as great a proportion of sufficiently large suspended matters to be retained on a screen having 4/10ths of an inch clear opening as do the sewages in Hamburg, Dresden and Frankfort?

Mr. Riker: Some objection.

The Commissioner: Note the objection.

A. No. In my opinion the longer time interval elapsing between the origin of the sewage in the various cities along the Passaic River and its mode of delivery to the screening works and the comminuting would reduce materially the size of the particles, making up the suspended matter in the sewage.

Q. How would this comminuting action affect the percentage removal by the proposed screens of the total suspended matters, the screens being approximately 4/10ths of an inch in mesh?

A. In my opinion the total suspended matter removed by screens having an opening of 4/10ths of an inch in the clear, from sewage of the age and condition to be expected from the Passaic Valley trunk sewer would be materially less in amount than the 10 per cent. of suspended matter I have previously stated.

Q. Mr. Greeley, have you studied Complainants' Exhibit No. 135?

A. Yes.

Q. Can the effluent stipulated for or the results guaranteed in that stipulation be produced by the plant described in that stipulation?

A. It is my judgment that they will not.

Q. From your knowledge, experience, observation and researches in sewage disposal on the operation of screens and sedimentation plants and basins; from your researches as to the septicity of sewage, the time it takes to become septic, in your opinion will the sewage contemplated to be taken into the Passaic Valley trunk sewer be septic or not at the time it reaches the trunk Sewer outfall at Robbins Reef?

A. I should say that it would be septic.

Q. Would or would not such sewage as I have described in my preceding question occasion a nuisance, and if so, state what kind of a nuisance?

3951 A. I should say that it would create a nuisance resulting from odors.

Q. And as to sight, what would you say?

A. I should say that the septic action as affecting the action of streams would make the removal of suspended matter less, and tend to increase the evidence of sewage in the harbor waters.

Q. What would be a main feature of difference between the sewages that you observed at Hamburg and Dresden and the Passaic Valley Trunk Sewages that would be delivered at the Newark Meadows?

Mr. Riker: The question is objected to as not being rebuttal.
The Commissioner: Note the objection.

A. I think the chief difference would be as to the freshness of the sewage, as that related to the size of suspended particles contained in the sewage.

Q. Does screening affect equally, so far as the removal of suspended matter is concerned, fresh sewage and septic comminuted sewage?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. No.

Q. Well, what is the difference in your experience, Mr. Greeley?

A. The fresh sewage contains the suspended matter in larger particles, which are more readily removed by screens having clear openings about 4/10ths of an inch.

Q. What does septicization and comminution do with respect to sewage and the screening of that sewage?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. It has an effect upon the efficiency of the screening, lowering the same.

Mr. O'Sullivan: Your witness, Mr. Riker.

Cross-examination by Mr. Riker:

Q. Are you a physician?

A. No, sir.

Q. Know anything about the causes of typhoid fever?

A. Something.

3952 Q. How did you gain your knowledge?

A. Through studies, chiefly.

Q. Did you drink any waters from New York Harbor?

A. No.

Q. You and your companion were afflicted with a case of typhoid fever, were you?

A. Yes.

Q. Do you know of any way in which typhoid can be given to a human being except through taking it in through the intestines, taking the germs in through the intestines?

A. Well, it can be taken in with drink or with food.

Q. Do you think that the experiences in the examination of the waters of New York Harbor had anything to do with your typhoid?

A. Why, I think the question is——

Q. Well, answer the question. It is not necessary to give your thoughts about it. Answer it, if you can.

A. Relating to the waters of New York Harbor, I do not think the experiences—I am not clear as to just what is meant by the experiences.

The question was then read by the stenographer.

Q. Do you think that the examination of the waters of Boston Harbor had anything to do with your typhoid?

A. Yes, I think they had.

Q. What?

A. I think that the examination of the sewage discharged into Boston Harbor was directly responsible for my typhoid fever.

Q. In what way?

A. In that I directly took typhoid germs from the sewage into my system.

Q. How did you take them in, in your opinion?

A. In making chemical analyses, we used a small tube in which we drew up samples of the sewage by suction. It is our belief that in that operation and in the late hours of the morning when we were tired and somewhat careless we became infected with the typhoid.

Q. You took, then, at practically the outlet of the Boston sewers, or from waters taken from the outlet of the Boston sewers into your mouth infected water, in your opinion?

A. Yes.

Q. Did you ever try the taking of the waters of New York Harbor, as they exist now, into your mouth?

A. No.

Q. To see whether you would get typhoid from it?

A. No.

Q. Why did you examine the sewage disposal works at Hamburg, Dresden and Frankfort?

A. As I already stated in order to gain data that would be of assistance in working out plans for sewage disposal for the City of Milwaukee.

Q. Why did you select those particular three places?

A. As having particular reference—as being particularly good examples of sewage screening plants.

Q. As being the best known disposal plants on a large scale that existed so far as you were informed, wasn't that it?

A. More particularly as relating to screens.

Q. Do you know of any sewage plants in existence for the disposal of sewage in a large way which are superior to those of Hamburg, Dresden and Frankfort.

A. As far as the disposal of sewage goes, I think there are several.

Q. Where are they?

A. Essen, Germany, I would mention one; in Birmingham, England.

Q. Any others?

A. No, those are the only two I think of now.

Q. In what respect do the disposal works at Birmingham excel those at Hamburg, Dresden or Frankfort?

A. They give a greater purification of the sewage.

Q. In what way do they accomplish it?

A. They have additional works other than the screens.

Q. What additional works?

A. Sedimentation basins and sprinkling filters.

Q. Neither at Hamburg, Frankfort nor Dresden is there any sedimentation process is there?

A. There is sedimentation at Frankfort.

Q. To what extent?

A. They have, following the screens sedimentation basins.

Q. Does the sedimentation system at Birmingham provide a detention period of not less than one hour at the maximum rate of flow of the sewage and a detention period of daily average flow of such sewage for not less than 1 hour and a half?

A. I have not those figures in mind now.

Q. Can you by resorting to your data determine whether or not the Birmingham system provides for as great a detention period as is indicated in that question?

A. No, I could get it only from such books which I have here.

Q. Well, can you compare then the efficiency of the Birmingham sedimentation tanks with those that are described in Complainants' Exhibit No. 135?

A. No, sir.

Q. You do not know whether they are superior or inferior at Birmingham to those that are provided for in the stipulation?

A. No, sir.

Q. What do they have at Essen that they do not have at Hamburg, Dresden and Frankfort in the way of purification processes?

A. They have a number of sedimentation plants.

Q. Anything else?

A. I would state particularly as a feature of their sewage purification scheme that the sedimentation plants are located as near the origin of the sewage as possible.

Q. Yes. You volunteered that, but I want to know what else. What other process have they at Essen that they have not at Frankfort, Hamburg and Dresden?

A. They have none.

Q. In what respect then, does the Essen plant exceed in efficiency that proposed by the stipulation which is Complainants' Exhibit No. 135?

A. I cannot answer that on account of the fact that I do not know in detail what is proposed in the Exhibit No. 135.

Q. You have not examined the exhibit?

A. Yes, I have examined it.

Q. But you do not know what it contains?

A. Not in detail; not what the proposed sedimentation basins are to be.

Q. And you mean to say that you have undertaken to testify as to the probable effluent from this plant without acquainting yourself with what the processes are that are prescribed in this stipulation?

A. Yes, as nearly as can be done on the description presented.

3955 Q. Then you are familiar with the description as presented?

A. Yes.

Q. And you are familiar with what is prescribed as to sedimentation?

A. Yes.

Q. Well, why did you say that you were not?

A. I said that I was not able to compare that with the actual working settling plant as you requested me to do with the plant at Essen.

Q. And you did not say that you were not familiar with what was prescribed in the stipulation?

A. Yes.

Q. Then if you are not able to tell what the actual results and operation of the plants that is prescribed in the stipulation may be, how can you testify as to the probable result of the effluent when delivered into the waters of New York Bay?

A. What is that question?

The Question was read by the stenographer.

The Witness: In accordance with the stipulations I can testify as to whether in my judgment the works described in general in the stipulation will fulfill those requirements.

Q. Well, do you think your judgment has any value based upon any such supposition as that?

A. I think it has.

Q. Then in your observation and to your knowledge, is there a plant in actual operation, which in your opinion is more efficient in actual operation than that prescribed in this stipulation, when treating sewage on a large scale, with the exception of Birmingham?

A. That I am unable to answer.

Q. Cannot give an opinion on it?

A. No.

Q. Why not?

A. The details of the plant are not sufficiently set forth to compare with particular plants.

Q. How do you undertake to predict what the effluent will be then, if the details are not sufficient for you to determine what the operation of the plant will be?

A. I have not predicted in detail what the effluent will be.

Q. How are you able to predict in a general way what the result of the effluent will be if you are not willing to say that you understand what kind of a plant will be erected in accordance with these specifications?

A. I understand in a general way what kind of a plant will be erected and can state what its general effect will be.

Q. Then in the general way in which you understand the effluent as likely to be produced under these specifications, how will it compare with other plans that you know of for the treatment of sewage on a large scale?

A. I should say that it would be less efficient than a number now in operation.

Q. Which ones?

A. I have already referred to those at Essen and Birmingham.

Q. In what respect will it be less efficient than the one at Essen?

A. It will produce more of an odor, will remove less total suspended matter, and the discharge into the water will be more evident.

Q. Now, with reference to the odor, why do you say that it will produce more odor?

A. Because of the age of the sewage.

Q. That is the only reason?

A. Yes.

Q. Has that anything to do with the character of the plant?

A. That particular statement has not.

Q. Then so far as the treatment plant is concerned, that has nothing whatever to do with the question of the odors?

A. Well, I would not say yes to that.

Q. Well, what would you say to it? Say what you please to it, only give an answer to it.

The question was read by the stenographer.

A. Yes, I think it has something to do with the question of the odors.

Q. Yes; what has it to do with the question of the odors, itself as compared with the plant at Essen?

A. In the first place the method of removing suspended solids by screens in my observation and judgment, is a great deal more likely to produce odors, than the method in operation at Essen.

3957 Q. What is the method at Essen to which you refer, which is superior to that which is proposed in this stipulation?

A. Sedimentation tanks of the double-deck type, located as nearly as possible to the origin of the sewage.

Q. Well, have you studied the sedimentation tanks that are described and prescribed in the stipulation which is Complainants' Exhibit No. 135?

A. I have not studied them as regards drawings or details, no.

Q. Can you say whether they are likely to be more or less efficient than those at Essen without such an examination.

A. I should say that any settling tanks built to treat sewage of the age to be expected in the Newark Meadows from the Passaic Valley Trunk Sewer would probably be less efficient than those located at Essen.

Q. That has to do, however with the age of the sewage and not with the design of the sedimentation tanks, isn't that so?

A. Principally.

Q. Unless you know what is actually intended by the stipulation and the settling tanks therein described, how can you say whether they are likely to be more or less efficient than those at Essen upon the same class of sewage?

A. I cannot, based upon the same class of sewage.

Q. Are you prepared to say that the settling tanks that are described in this stipulation which is Complainants' Exhibit No. 135 will be less or more efficient than those at Essen and operated upon the same class of sewage?

A. No.

Q. Don't know anything about it?

A. No, I cannot make a definite answer.

Q. Now, at Birmingham you say they have introduced into the disposal works, sprinkling filters?

A. Yes.

Q. That is the only thing that is superior to the Essen plant?

A. That is an addition, yes.

Q. Is that the only device at the Birmingham Works that in itself is superior to those in use at Essen?

A. In the main, yes.

Q. How long have those sprinkling filters been operating at Birmingham?

A. I cannot say exactly. I should say at least four years.

3958 Q. What is the population served by the disposal plant at Birmingham?

A. I have a note here that in 1908 the sewage plant treated the flow from a sewerage district of about 900,000 people.

Q. Where is the effluent discharged?

A. I fail to have that noted here.

Q. Did you examine the Birmingham system?

A. Several years ago, yes.

Q. Can't you say in a general way where the effluent is discharged, into what water?

A. The sewage of Birmingham is discharged into a stream.

Q. What stream?

A. The name is not noted here. I shall have to look further.

Mr. Riker: Well, I will withdraw the question if you cannot remember.

Q. Have you seen the point of discharge of the effluent at Birmingham?

A. I don't remember seeing its discharge into the stream, no.

Q. I ask you whether you had ever seen the point of discharge?

A. Meaning the point into the stream or the discharge from the plant?

Q. I mean the point in the stream of the discharge?

A. No.

Q. You don't know how far it is from Birmingham?

A. The plant is located some 5 or 6 miles from Birmingham.

Q. Through what cities or towns does the stream flow, after the discharge is made into its water from the disposal works at Birmingham?

A. I can't tell you.

Q. How far from the sea is Birmingham?

(Witness examines papers.)

A. I shall see.

Q. You do not know of your own recollection?

A. No.

Q. Is Birmingham an inland city or is it not?

A. To the best of my recollection Birmingham is an inland city.

Q. Did you examine at any time the waters of the stream into which the effluent was discharged for the purpose of determining what effect that discharge had on the waters?

A. No.

Q. Why not?

A. I did not have opportunity conveniently to do it at the time of my visit.

3959 Q. With reference to the built-up part of the City of Hamburg, where is the disposal plant located?

A. It is located on the water front, not far from the built-up portion of the city.

Q. How far?

A. Adjacent to it.

Q. Well, can't you tell me in miles or parts of miles, or feet or yards?

A. Less than a mile.

Q. How much less than a mile?

A. Well, it is right on the edge of the built-up district of the city along the water front.

Q. And at Dresden, where is the disposal plant located?

A. About two miles below the town; probably about a mile and a half below the town.

Q. Is it open, unoccupied country, from what you define as the town to the disposal works?

A. Yes, distinctly so.

Q. And beyond, what is there?

A. As far as I could see there was open farming country.

Q. Farming country?

A. Yes.

Q. Well, is the country between the disposal plant and the city farming country?

A. Part of it is. It begins to build up within half a mile of the plant up stream I should say.

Q. Where is the plant at Dresden with reference to the built-up part of Dresden?

A. I have just answered that question.

Q. Frankfort then?

A. The plant at Frankfort is located on the opposite side of the river from the main part of the town, and I should say about a mile from it.

Q. Is the opposite side of the river built up at all?

A. Not directly opposite.

Q. Near the plant, how is it with reference to being built up?

A. There are no buildings immediately adjacent to the plant, say not within a third of a mile.

Q. Well outside of that radius of a third of a mile, is it built up?

A. It is not built up compactly.

Q. What character of buildings are they?

3960 A. Chiefly second class suburban residential houses.

Q. Are you familiar with the Newark Meadows?

A. I have been across them.

Q. You did some work in connection with this Passaic Valley Sewerage project, did you not?

A. Yes.

Q. Can you identify or recollect the location of the proposed disposal plant?

A. Not in detail.

Q. Well, in a general way can you?

A. I have never seen the location definitely determined.

Q. Are you familiar with the Newark Meadows?

A. I have passed across them on a train.

Q. Are they built-up to as great an extent as the territory surrounding the Hamburg Disposal plant?

A. No.

Q. Or the Dresden plant?

A. There is not such a big difference there.

Q. Or the Frankfort plant?

A. No.

Q. Or the Birmingham?

A. I don't recollect the character of the surroundings at Birmingham.

Q. Essen. How do they compare with the location of the Essen plant?

A. The Essen plants are more centrally located.

Q. Are you familiar with the plant at Washington, D. C.?

A. No, I don't know just what you refer to.

Q. The disposal plant at Washington, D. C.?

A. No, I am not familiar with it.

Q. You never have seen it, have you?

A. I have seen the sewage pumping station at Washington, but I have not known of the disposal plant there.

Q. Well, is there any screening work there?

A. Yes, there are some bar screens.

Q. Well, that particular work at Washington; how does it compare in location with the location of the Newark Meadows?

A. I should say it was more central.

Q. In your opinion would the nuisance be more serious and more apparent at any one of these plants or all of them than at the proposed Newark plant?

3961 A. What is that question, please?

The stenographer thereupon repeated the question.

A. I think it would not.

Q. You don't think it would be more serious at Washington?

A. Not in accordance with the plants as they exist.

Q. Do you think it would be less or more serious the same operations, at the plant at Hamburg, than they would be at the proposed plant on the Newark Meadows?

A. I think somewhat more so.

Q. Same operations at the Frankfort plant, would they be more apparent or more serious in the way of a nuisance than they would be at the proposed plant on the Newark Meadows?

A. If you could have the same conditions existing at Frankfort, as you would have at the Newark Meadows, but the Frankfort plant receiving fresh sewage—

Q. I did not ask you that, Mr. Greeley, the same conditions I am speaking of.

The stenographer thereupon read the question.

The Witness: Somewhat more so.

Q. Why?

A. Because of the somewhat greater proximity to the town.

Q. Do you know how far the proposed plants of the Passaic Valley Sewerage Commissioners are distant from the nearest point of the State of New York?

A. No.

Q. Can't you approximate?

A. No, I cannot.

Q. Would you say it was nearer than 5 miles?

A. I should say so.

Q. How much nearer?

A. I could not say.

Q. Why do you say it is nearer than 5 miles if you cannot form any estimate?

A. That is just my impression.

Q. That is an impression merely. Do you think the odors from the Newark plants will reach the territory of New York?

A. I think they might.

Q. Under what conditions?

A. Under favorable atmospheric conditions.

Q. Describe these favorable atmospheric conditions under which you think that the odors from this disposal plant would reach New York?

3962 A. A wind in the right direction.

Q. What else, is that all?

A. That would be the chief consideration.

Q. Would those conditions differ in any way from the odors carried from Hunter's Point to New Jersey under favorable winds?

A. I am not familiar with the location of Hunter's Point.

Q. You don't know the oil distilleries there?

A. In Bayonne?

Q. Now, I did not ask you about Bayonne; I asked you Hunter's Point; do you know where Hunter's Point is?

A. No, I am not familiar with it.

Q. When did you graduate from Harvard?

A. In 1903.

Q. And you differ in your opinion from the opinion of Mr. Johnson?

A. In certain respects.

Q. Were you under Mr. Johnson's direction during part of your career?

A. Yes.

Q. What screens do you understand are to be used in the Passaic Valley Disposal plant?

A. Mr. Johnson has spoken of them as screens of the Hamburg type.

Q. Is that all you know about it?

A. I have not seen a description any other place.

Q. You have not seen a description anywhere else?

A. Not of that detail, no.

Q. Have you read the stipulation which it contained in Complainants' Exhibit No. 135?

A. Yes.

Q. And does that indicate to you what the screens will be?

A. Just states that they shall be self cleansing mechanical screens, having clear openings of not over 4/10ths of an inch.

Q. Does that describe the Hamburg type or doesn't it.

A. In a general way.

Q. Mr. Greeley, if the effluent as produced by the Passaic Valley Sewerage plant and discharged at Robbins Reef into New York Bay under the conditions described in the stipulation being Complainants' Exhibit No. 135, results in the guaranteed results of this stipulation, will there be any nuisance created in New York Bay?

A. What is that question?

The stenographer thereupon read the question.

The Witness: I think no serious nuisance.

Q. Well, any nuisance?

A. I think no serious nuisance.

Q. Do you know what a nuisance is?

A. A nuisance is a relative term applied to something that affects the public describing a condition that affects the public deleteriously.

Q. You have qualified your answer by saying that there will be no serious nuisance. What nuisance of any kind, serious or not, in your judgment, will be produced by the effluent as described, which produces the results described in the stipulation which is Complainants' Exhibit No. 135 (Handing witness Exhibit No. 135)?

A. I think that if the stipulations as stated in Complainants' Exhibit No. 135 are fulfilled, that there will be no public or private nuisance created thereby.

Q. Well, what did you intend by your qualification of your answer by serious nuisance?

A. There is stated in the stipulation that there will be practical absence on the surface of New York Bay of any grease or color that might create some slight nuisance.

Q. Yes, but, Mr. Greeley, reading the whole of these guaranteed results and bearing in mind that the stipulation is that there shall be no nuisance in New York Bay, are you willing to say that there will be?

A. Not if the conditions of the stipulation are fulfilled.

Q. Well, then, you don't want to qualify yourself at all do you, by the word "serious"?

A. No.

Q. You wish to withdraw it?

A. Yes.

Q. Is it possible to produce an effluent which will fulfill the results guaranteed in the stipulation, Complainants' Exhibit No. 135 in your opinion?

A. I think that is possible.

Q. In your opinion as an expert in these matters, has dilution anything to do with the safe disposal of sewage?

3064 A. I think it has to do with the disposal of sewage as regards the prevention of a nuisance.

Q. In your opinion can the same amount of sewage of the same quality be more safely discharged, so far as nuisance is concerned, into a large body of water than into a small body of water?

A. That depends upon the uses and environments of the two bodies of water, those conditions being equal the largest body would be the safer into which to discharge it.

Q. I understand you to say that you have not been able to determine from the processes and plants described in the stipulation, Complainants' Exhibit No. 135, just what type of plant will result; am I right in that?

A. Yes.

Q. Therefore you cannot say what the effluent will be, can you?

A. Not in detail, no.

Q. You can't therefore, say what additional appliances or processes might in your opinion be required to produce the effluent which will result as guaranteed in this stipulation?

A. No.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Is it possible to produce the effluent stipulated for in Complainants' Exhibit No. 135 with the plant described in that exhibit?

A. I think not.

Q. Do colloidal matters undergo putrefactive changes?

A. I understand that they do.

Q. Do these putrefactive odors occasion nuisance?

A. They do.

Q. Is there any provision in Complainants' Exhibit No. 135 for the elimination of the colloidal matters that will be likely to occasion that nuisance?

A. No.

Q. Do pathogenic germs that occasion disease such as typhoid fever—would you regard those as a nuisance in a sewage effluent?

A. Yes.

Q. Is there any provision in Complainants' Exhibit No. 135 to eliminate the pathogenic germs from the effluent?

A. No.

Q. If an effluent such as is guaranteed or stipulated for in its

3965 results as set forth in Complainants' Exhibit No. 135 was produced, would it occasion any greater nuisance in Newark Bay than it would in New York Bay?

A. No.

Q. Does the age of sewage affect its sedimentation?

A. Yes.

Q. In what way?

A. In a general way, the older the sewage, the less the efficiency of sedimentation.

Q. How would the sewages of Hamburg or Birmingham compare in that respect with the proposed amount of sewage to be delivered at the Newark Meadows in the Passaic Valley Trunk Sewer project?

A. They would be fresher.

Q. You mentioned sprinkling filters. Will you describe what you mean by the term sprinkling filters?

A. A sprinkler filter is a bed of broken stone about 6 feet deep, the stones being proportioned in varying sizes from 1 inch to 2½ inches in size over which the sewage is sprinkled and allowed to trickle over the stones and through the interstices into under-drains, provided at the bottom of the stone beds.

Q. Is that an advanced mode of purifying the sewage effluent?

A. Yes.

Q. Is there any such provision for the purification of the sewage effluent to be produced as set forth in Complainants' Exhibit No. 135?

A. No.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. Now, Mr. Greeley, in what respect does the discharge of pathogenic germs into the waters of New York Bay constitute a nuisance in your opinion?

A. Well, I think it is deleterious to the public.

Q. In what way?

A. In that it creates a possibility of increasing the death rate.

Q. That is what you define as a nuisance, is it?

A. I think that could be classed as a nuisance.

Q. And does the production of a nuisance in that way depend in any way, in your opinion, on the conditions of the water into which pathogenic germs may be discharged?

A. Yes.

Q. If the waters are already polluted by the crude sewage of a population of four or five millions of inhabitants, does that have any effect upon your judgment as to whether an addition
3966 of pathogenic germs will be a nuisance or not?

A. No.

Q. It has no effect?

A. No.

Q. Do you think that where a nuisance already exists, it would

exist, would it not, from the discharge of crude sewage from four or five millions of inhabitants into the waters of New York Bay?

A. I think so.

Q. Where such a nuisance exists, you think the discharge of pathogenic germs constitutes a nuisance?

A. Yes.

Q. Well, as compared with the discharge of pathogenic germs indirectly through the waters of the Passaic River, Newark Bay and the Kill van Kull into New York Bay, do you think the discharge of pathogenic germs from this sewer will constitute any further nuisance?

A. As a comparison between the transmission of the germs by way of the Passaic River, Newark Bay, the Kill von Kull and the trunk sewer, I think there would be a greater nuisance as relates to New York Bay by way of the trunk sewer.

Q. Why?

A. I think that the germs would proceed under more favorable conditions to the outlet in New York Bay.

Q. Why?

A. I think that there would be greater natural conditions tending to destroy the germs in the passage through the river and the Newark Bay and the Kill von Kull.

Q. What are those natural conditions in your opinion?

A. Trade wastes in the river; the temperature of the river water as being lower than the temperature of the sewage. I mention those as a few.

Q. You are bearing in mind, are you, that the trade wastes are to be discharged through the sewer?

A. It is my understanding that all of the trade wastes are not to be taken through the sewer.

Q. It is your understanding, is it? That is what you base your answer on with reference to the pathogenic germs?

A. In part, yes.

Q. Well, what would be the difference in the temperatures of the river waters which discharge directly through the Kill von
3967 Kull into New York Bay as compared with the temperatures of the sewage when discharged at Robbins Reef?

A. The sewage in the River water and the Newark Bay would in my judgment be less.

Q. The temperature would be lower?

A. Lower.

Q. How do you reach that conclusion?

A. That is my opinion.

Q. Well, what is it based on?

A. On observations of the temperature of sewage and the temperature of flowing streams.

Q. Observation of temperature of the streams into which sewage is discharged directly as compared with the temperature of sewage flowing through a trunk sewer. You made those comparisons, did you?

A. Yes.

Q. Where?

A. At Hamburg, and I found the temperature of the sewage coming out of the main trunk sewer, which was comparatively fresh sewage to be 68.9 degrees Fahrenheit and the temperature of the Elbe water to be 66.2 under summer conditions.

Q. That is 3 degrees difference, about?

A. Yes, I would expect under winter conditions that it would be very different.

Q. And would you expect any difference from the sewage being what you have termed old as to temperature?

A. Yes.

Q. Would it be higher or lower?

A. I would expect it would be higher.

Q. If it is old?

A. Yes.

Q. How much higher?

A. I can't say in precise terms.

Q. What effect would the carrying of it through a deep tunnel have upon the temperature in your opinion; increasing the temperature or decreasing the temperature of the sewage?

A. I should say that if it was fresh sewage it would tend to decrease—I should say if it was any sewage, it would tend to decrease the temperature slightly.

Q. Now, Mr. Greeley, you were asked on redirect whether an effluent as described in stipulation, Complainants' Exhibit No. 135, which produced the results guaranteed in New York, would also produce the same results in Newark Bay. Is it your opinion that an effluent when discharged at Robbins Reef at the depth it is stipulated and in the way it is stipulated, and resulting in the absence of visible suspended particles in New York Bay, would also result in an absence of visible suspended particles if discharged into Newark Bay?

A. Yes.

Q. The depth of the water has nothing to do with that?

A. No.

Q. The depth of the water would have no effect upon it, in your opinion?

A. No, not in the positive way stated.

Q. Well, do you think that if there was an absence of visible suspended particles resulting from the discharge of the effluent in New York Bay at Robbins Reef that necessarily the same effluent discharged in Newark Bay would result in the absence of suspended particles in Newark Bay?

A. Yes.

Q. The quantity of the water has nothing to do with this result in your opinion?

A. Not as between these two places.

Q. Why not?

A. Because the difference is not sufficient.

Q. Well, what is the difference?

A. I can't tell you that in precise figures.

Q. Well, what difference would be sufficient to make a difference in the results in your opinion?

A. Well, it would be a very great difference?

Q. Well, how great?

A. The discharge into a small river compared with the discharge into New York Bay.

Q. That would be sufficient in your judgment, would it, to account for a difference in this result?

A. Yes, sir, to account for a difference.

Q. What is the volume of water in Newark Bay?

A. I am not familiar with those figures.

Q. What is the volume of water in New York Bay?

A. I am not familiar with those figures.

Q. What are the depths of the water in Newark Bay?

A. I am not familiar with that.

Q. How deep would it be possible to discharge an effluent
3969 into Newark Bay.

A. I am not familiar with that.

Q. How can you testify then, that the effluent which will produce the guaranteed results in New York Bay will produce the same results in Newark Bay, if you do not know the elements of the problem?

A. I can express my opinion based on such observations and connections with the work as I have had.

Q. And having such value as your opinion may have under those conditions?

A. Yes.

Q. Now, an effluent which will result in the absence in New York Bay and its vicinity of odors due to the putrefaction of organic matters contained in it, will result, in your opinion, in the same way if discharged into Newark Bay?

A. Yes.

Q. Does the body of water in your opinion have anything to do with this result?

A. As comparing Newark Bay and New York Bay and the character of effluent stipulated, I should say not.

Q. Have you in answer to this question and in the mean while and since the last questions were put to you, obtained any further knowledge as to the quantity of water in Newark Bay?

A. No.

Q. And in New York Bay?

A. No.

Q. And are the quantities of water, the relative quantities of water in these two bodies of any importance in determining and giving a value to your opinion?

A. I think so.

Q. You don't know any thing about the relative quantities then?

A. Not in precise figures.

Q. Well, in a general way what do you know about them?

A. I think in a general way that there is not sufficient difference to make the discharge different in the two bodies.

Q. Upon what do you base that and what do you intend by — in a general way?

A. I mean that I am not familiar with the precise quantities of water in Newark Bay and New York Bay, but that I have observed them, so that in a general way in my opinion, the effluent as stipulated will not create differences, if discharged into the two bodies.

3970 Q. Now, what is the effluent which is stipulated?

A. Stipulated in Complainants' Exhibit No. 135.

Q. What is the effluent as stipulated in Complainants' Exhibit No. 135? Describe it?

A. I refer to the conditions to be produced rather than to the effluent, because the effluent is described by the conditions which it will produce or which it will not produce.

Q. Well with the effluent described in your opinion?

A. Well, the conditions which it will not produce are stated.

Q. And your answers to the question on your redirect examination was that the conditions produced in New York Bay would be produced in Newark Bay?

A. Yes, sir, if the stipulation——

Q. (Interrupting.) That it would be the same effluent?

A. I did not intend to make that statement. If the effluent conformed with the conditions required of it in New York Bay, it could be discharged with similar effects in Newark Bay.

Q. But the same effluent that produced the results guaranteed in New York Bay if discharged into Newark Bay would produce the same results?

A. Yes, sir.

Q. And you would say, would you, that an effluent which in a body of water of the size and capacity of New York Bay would result in the practical absence of odors due to the putrefaction of organic matters when discharged into a body of water of the size and capacity of Newark Bay, would result in the absence of odors due to the putrefaction of organic matters?

A. Yes, the condition of the effluent being the same or similar.

Q. The effluent being the same?

A. Yes, sir.

Q. The quantity of water has nothing to do with that, has it?

A. The quantity of water as relates to these two bodies, in my opinion, has nothing to do with this.

Q. Does the quantity of water have any effect upon the production of odors from an effluent, the same effluent discharged into it?

A. Yes.

3971 Q. Well, will you tell me in multiples or in any other way at what point the difference in the volume of water is important?

A. That depends so largely on so many conditions that I cannot give a definite statement in numbers.

Q. Well, are you assuming the same effluent?

A. Under what conditions?

Q. The same effluent in all respects. If you will assume that. Now, what other conditions do you want to assume for your comparison?

A. Will you read that original question again, please?

The stenographer thereupon read the question referred to as follows:

Q. Well, will you tell me in multiples or in any other way at what point the difference in the volume of water is important?

The Witness: I should say that if the discharge of this similar effluent into water of 75 times its volume, that above that ration there would be very little difference in its effect on the body of water.

Q. That is to say if the bodies were less than 1 to 75?

A. Yes.

Q. There would be very little effect?

A. No, more. That is if the body of water contained more—was a greater proportion than 75 times.

Q. You mean to say that discharge into a body of water which would be represented by 1 might not safely be made, whereas it could safely be made into a body of water representing 75 or over?

A. That was not exactly what I meant. What I meant was that if discharged into a body of water of which it was 1/175th in volume, and if it was then discharged into a volume of water of which it was, say 1/100th, the resulting condition would not be different.

Q. Well, Mr. Greeley, assume that an effluent is being discharged into the waters of New York Bay of just that sufficient clarity and purified to that degree, that there will be there an absence of odors due to the putrefaction of organic matters contained in the effluent: do you think that effluent will be discharged into Newark Bay and that there would then be no odors in Newark Bay due to the putrefaction of organic matters?

A. Yes.

3872 Q. Well, into a body of water half the capacity of Newark Bay, do you think it would be safe to discharge an effluent that would produce the results guaranteed in New York Bay?

A. I don't know as to that.

Q. Well, do you know as a matter of fact the difference in the results in Newark Bay and New York Bay?

A. That is my opinion based on what I know of the two waters. I stated that I did not know the precise figures.

Q. Well, what is the depth of New York Bay?

A. That is variable. I understand that the effluent is to be discharged into 40 feet of water so that at parts of New York Bay, the depth of water would be 40 feet.

Q. Well, it is greater in other parts?

A. That I am uncertain about definitely.

Q. Well, in multiples, what do you understand to be the difference in capacity between New York Bay and Newark Bay?

A. I have not got that.

Q. Well, has that any influence upon your opinion as to the

results of discharging the same effluent into these two bodies of water?

A. Not the exact figures.

Q. Well, the general figures in a general way? Can't you give me some idea of what the difference in capacity between these two bodies of water is?

A. No.

Q. Well, if the difference is 1,000 to 1, would that have any effect upon your judgment as to the safety of discharging the same effluent into these two bodies of water?

A. Yes.

Q. Do you know whether the difference is as great as 1,000 to 1?

A. I have not the figures to state that.

Q. Well, then, how can you express any opinion in regard to this problem, Mr. Greeley?

A. I have an opinion as to the effect on the two waters.

Q. An effluent which in the discharge into the waters of New York Bay at Robbins Reef will produce no grease or color due to its discharge; do you think when discharged into Newark Bay, it will necessarily have the same result?

A. Yes, I do.

3973 Q. Why?

A. Because I think that if no grease were evident on New York Bay that the removal would be sufficient to make the same conditions hold in Newark Bay.

Q. The quantity of water has nothing to do with that problem, then?

A. Not as between the two bodies of water.

Q. I will ask you whether the quantity of water theoretically, without reference to these two bodies of water in your opinion would have any effect in this respect?

A. As to the general discharge of sewage into water, it has an effect.

Q. I am asking as to the production of color, grease or color, whether the quantity of water has anything to do with the production of grease and color from an effluent discharged into it?

A. Yes.

Q. Well, at what point, where does it begin to have an influence?

A. That depends on so many local conditions that I cannot give a precise answer.

Q. Now, assume that the effluent is identical, and assume that the waters are similar in quality, will a discharge of an effluent which in a body represented by 1 in volume and producing color and grease when discharged into a body of water represented by 1,000 produce color and grease?

A. I think it would.

Q. Where is the point at which there will be a difference in result?

A. I can't say definitely.

Q. You said that there would be, you remember, in your opinion?

A. Yes.

Q. Well, would it be in a ratio of 1 to 5,000?

A. I cannot say definitely as to that.

Q. Would it be 1 to 1,000,000?

A. There would undoubtedly be a difference between those two dilutions.

Q. What is the ratio between the water of Newark Bay and that of New York Bay in quantity?

A. I do not know.

Q. Is it 1 to 1,000,000; is it as little as 1 to 1,000,000?

A. No.

3974 Q. How do you know?

A. From my observation of the two bodies of water.

Q. Your observation has been confined to the surface, has it not?

A. Yes.

Q. You would not place the importance of the volume at a ratio below 1 to 1,000,000?

A. Not in precise terms.

Q. Well, I did not ask you to put it in precise terms, but I asked you would you place it lower than 1,000,000, anywhere lower than 1 to 1,000,000?

A. I should say that it was less than 1 to 1,000,000.

Q. Would it be less than 1 to 500,000?

A. I should say that it would.

Q. Yes; as a matter of fact do you know where it would be?

A. Not in precise terms.

Q. Now, an effluent which discharged into New York Bay under conditions described in the stipulation which is Complainants' Exhibit No. 135, and occasions no public or private nuisance in your opinion would that effluent when discharged into Newark Bay necessarily produce no private or public nuisance?

A. I think not.

Q. Has the volume of water in the two bodies described anything to do with this result?

A. Not to the relation of New York Bay and Newark Bay.

Q. And is your answer to this question based upon any other or more precise information than you have obtained by observing the surface of these two bodies of water?

A. No.

Q. It is not based upon any acquired knowledge of the actual volume of the water of the two bodies?

A. Not which I have in mind in precise terms at the present time.

Q. Well, what have you in mind; have you anything in mind as to the relative volumes of these two bodies of water?

A. Not in precise terms.

Q. Well, what have you, if anything, in mind, except your observation of the surfaces?

A. No other precise features.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

3975 Q. Mr. Greeley is Newark Bay and New York Bay subject to the same tidal phenomena and the refreshing and other influences of that phenomena?

A. Not exactly the same.

Q. If an effluent will produce no public or private nuisance, will it make any difference as to what body of water it is discharged into?

A. No.

Q. Will grease rise to the surface no matter how large or how small the body of water into which an effluent containing it will be discharged?

A. Yes.

Q. What was the ratio of dilution beyond which you stated it made no difference to the relative volume of the bodies of the diluent waters?

A. As I recollect it was between ratios of 1 to 75 and 1 to 125.

Q. And beyond that the relative capacities of the diluent waters mattered little for an effluent such as was guaranteed in its results in Complainants' Exhibit No. 135?

A. Yes.

Recross-examination by Mr. Riker:

Q. Mr. Greeley, one question. You said now, on your examination that an effluent which resulted in no public or private nuisance in New York Bay, would result in no public or private nuisance if discharged anywhere into any body of water; did I understand you correctly to say that?

A. No, I did not intend to say that?

Q. Well, what did you intend to say?

A. Read that question please.

The stenographer thereupon read the question.

Q. Having had that read to you, do you mean to stand by that as your answer?

A. Yes.

Q. That an effluent which would produce no public or private nuisance in one body of water, no matter how large, could be safely discharged into any body of water, however small?

A. As I understand it, that is a somewhat different question. I think the quantity of water does have an effect.

Redirect examination by Mr. O'Sullivan:

3976 Q. Can you produce an effluent that is good enough to drink; that will be potable?

A. Not potable to the general public.

Q. Can you distill the sewage effluent so as to get absolutely pure water from it?

A. You can.

Q. Would such an effluent create a public or a private nuisance?

A. I should say not.

Mr. O'Sullivan: That is all.

Adjourned to May 29th, 1913, at 10:30 A. M.

Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COM-
MISSIONERS, Defendants.

NEW YORK CITY, May 29th, 1913—10:30 A. M.

Before James D. Maher, Esq., Commissioner.

Appearances: William J. O'Sullivan, Esq., Special Counsel for the People of the State of New York, Complainants;

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

3977 Met pursuant to adjournment.

EMIL KUICHLING, a witness in behalf of the Complainants, recalled, in rebuttal, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Mr. Kuichling, have you testified previously in this suit?

A. I have sir.

Q. Have you been present and heard all the testimony offered by the defendants in this suit at the hearings held in Newark, New Jersey?

A. I have.

Q. Did you take notes of the testimony of each witness called on the presentation of the Defendants' testimony in this suit?

A. I did, sir.

Q. Did you subject to study and analyses the statements made by these witnesses and did you compare them with the records of your own experience and the scientific experiences of recognized scientists?

A. I did.

Q. Have you studied the location of the proposed outlets of the sewage of the Passaic Valley District near Robbins Reef Light in Upper New York Bay, and if so, will you describe the results you have reached in those studies?

Mr. Riker: The question is objected to on the ground that it is not directed to any testimony of the defence, and is not rebuttal.

The Commissioner: Note the objection of Counsel for the Defendants.

A. According to the plans of the Passaic Valley Sewerage Commission, the sewage of the Passaic Valley District is to be discharged through a series of 150 outlets which are located within an irregular area of 2.35 acres. This area is about 505 feet long in a south-

asterly direction and 205 feet wide in a southeasterly direction. The northwest corner of this area is 1455 feet due east and 641 feet due south of Robbins Reef Light, and its southwest corner is 1166 feet due east and 1047 feet due south of said Light.

3078 A straight line joining these two corners is about 505 feet long, and has a course or bearing of north 36 degrees 20 minutes east. The center of gravity of the said 150 outlets is about 33 feet northwesterly of the middle of the straight line just described, or is 1286 feet due east and 814 feet due south of said light; it is 1522 feet distant from said light on a course south 57 degrees and 40 minutes east. At low tide the depth of water in this area is mostly about 40 feet and it increases to 50 feet at the eastern edge near which the otherwise level bottom begins to slope downward. Robbins Reef Light is located about 2270 feet or 0.43 miles, due north of that portion of the boundary line between the States of New York and New Jersey which runs westerly from Upper New York Bay through the Kill Van Kull, and about 3430 feet or 0.65 mile, northwesterly from that portion of said boundary line which runs northeasterly through Upper New York Bay from the Kill Van Kull to the mouth of the Hudson River. Said Light is also 4.0 miles south of Battery Point in Manhattan Borough, 0.86 mile north of the Municipal Ferry House at St. George on Staten Island or Richmond Borough, 1.95 miles west of the shore at Bay Ridge in Brooklyn Borough, and 1.27 miles east of Constable Point in Bayonne, New Jersey. These latter figures are derived by scale measurements on a chart of New York Harbor published by the United States Coast and Geodetic Survey in February 1910, being Complainants' Exhibit Nos. 171 and 171A, and differ slightly from the corresponding figures given in my previous testimony, which figures were derived from the map of New York and vicinity published by the United States Geological Survey in 1909.

Q. Mr. Kuichling, have you studied the tidal currents in Upper New York Bay in the vicinity of Robbins Reef Light, and if so, state how much the sewage of the Passaic Valley District will be diluted with Bay water on being discharged in calm weather?

Mr. Riker: Same objection.

3079 The Commissioner: Note the objection.

A. To comprehend the results of the discharge of 360,000,000 gallons of sewage per day, or 557 cubic feet per second, at the locality just described by me, it is necessary to study very closely the topography or conformation of the bottom of the entire Upper New York Bay, as shown by complainants' Exhibit No. 126, and also to keep in mind the observations that have been made on the peculiarities of the tidal currents at said locality. The tendency of the sewage to rise to the surface by reason of its smaller specific gravity than that of the salt water into which it is discharged is likewise a highly important factor. To facilitate such study, I have drawn from the aforesaid chart of the United States Coast & Geodetic Survey, and herewith submit a set of five cross sections through Upper New York

Bay and also a profile of the bottom of said Bay along the line of the deepest points.

(Witness hands counsel paper.)

Q. What do these charts that you have just handed me portray or represent, Mr. Kuichling?

A. The drawing represents a series of five cross sections of Upper New York Bay and also a profile of the bottom of Upper New York Bay taken along the line of deepest water. Cross Section No. 1, as marked on the drawing, is taken 500 feet south of the mouths of the Hudson and East Rivers, beginning on the left at the bulkhead line of Jersey City, New Jersey, a short distance south of the ferry house of the Central Railroad of New Jersey, and running thence on a course south 69 degrees 27 minutes east to the bulkhead line of Brooklyn near the foot of Remsen Street. This section is practically through the northern end of Upper New York Bay.

Mr. O'Sullivan: I offer this chart or map showing the cross sections of New York Upper Bay and this profile, prepared by this witness, in evidence, and ask that it be marked Complainants' Exhibit No. 205.

Mr. Riker: The offer is objected to on the ground that it is 3980 not relevant and that the paper offered has not been properly proved, so as to become evidence in the case.

The Commissioner: Note the objection of Counsel for the Defendants.

Received in evidence and marked Complainants' Exhibit No. 205.

Q. Directing your attention now to Complainants' Exhibit No. 205, Mr. Kuichling, I ask you what the cross section marked No. 2 represents and where it was taken or made?

Mr. Riker: The question is objected to on the ground that it does not call for any answer in rebuttal of any testimony offered for the defense.

The Commissioner: Note the objection of Counsel for the Defendants.

A. Cross section No. 2 is taken at 6500 feet or 1.23 miles south of the mouth of the Hudson River, beginning on the left at the shore line of Jersey City, in the district known as Communipaw, about 1700 feet north of the long pier of the Lehigh Valley Railroad, and running thence on a course south 55 degrees 18 minutes east passing about 1076 feet northeast of Bedloe's Island and 400 feet southwest of the foot of Governors Island, to the bulkhead line of Brooklyn at the foot of Partition Street or the point called Red Hook.

Cross Section No. 3 is taken at 19,900 feet or 3.77 miles south of the mouth of the Hudson River, beginning on the left at the shore line of Bayonne, New Jersey, 6590 ft. south of the new long terminal pier of the Pennsylvania Railroad, and running thence on a course south 66 degrees 44 minutes east through Robbins Reef Light and the northern part of the area on which the proposed outlets of the sewages of the Passaic Valley District are located, to the bulkhead line

of Brooklyn at the foot of 63rd Street, which is 2890 feet northerly of the pier at Bay Ridge.

3281 Cross section No. 4 is taken at 29,800 feet, or 5.65 miles south of the mouth of the Hudson River, beginning on the left at the shore line of Stapleton, Staten Island, or Borough of Richmond, near the foot of Canal Street, or about 2.13 miles southerly of Robbins Reef Light, and 1.25 miles south of the ferry house at St. George; and running thence on a course North 82 degrees 10 minutes east to the shore line of Brooklyn at the foot of 83rd Street, which is 3270 feet south of the aforesaid pier at Bay Ridge and 1.48 miles north of Fort Lafayette at the Narrows.

Cross section No. 5 is taken through the Narrows on a line through Fort Wadsworth on the left and Forts Lafayette and Hamilton on the right. This line is 38,850 feet or 7.35 miles south of the mouth of the Hudson River, and is the southern end of Upper New York Bay. It should be mentioned that all the aforesaid distances of these cross sections from the mouth of the Hudson River are measured along the curved line of greatest depth of water, and that if measured in a straight line, the distance from the middle of cross section No. 1 to the middle of cross section No. 5 would be 6.49 miles. The cross sections shown on Exhibit No. 205 are drawn as if looking north from the point where each section was taken.

The profile of the bottom of Upper New York Bay, shown on Complainants' Exhibit No. 205 is taken along the line of greatest depth of water indicated on the said Chart of New York Harbor published by the United States Coast and Geodetic Survey in February 1910, which chart has been marked Complainants' Exhibit Nos. 171 and 171A. The longitudinal distances inscribed on this profile are measured along the line of deepest water from cross section No. 1 southerly to cross section No. 5 aforesaid, and beyond these limits the distances northerly up the Hudson River and southerly down Lower New York Bay can be determined readily from the engraved scale. An examination of this profile shows that the bottom is very irregular, the depth at low water ranging from 46 feet to 116 feet, with numerous elevations and depressions whereby the general directions of the tidal currents are modified materially.

3282 Cross section No. 3 deserves particular attention as it passes through Robbins Reef Light and also nearly through the center of the said group of 150 sewage outlets. As will be seen by reference to the drawing in Complainants' Exhibit 205, the entire cross sectional area of the water is divided naturally into three parts. The first part extends from the Bayonne shore to Robbins Reef Light, a distance of 2.414 miles, or 12,746 feet, has a maximum depth of 115 feet at low water, and an area of 17.48 per cent. of the total area. The second part extends from Robbins Reef Light to the middle of a long bar near the Brooklyn shore, has a width of 1.408 miles, or 7,432 feet, a maximum depth of 66 feet at low water and an area of 62.64 per cent. or a little more than $\frac{5}{8}$ ths of the total area. The third part extends from said bar to the Brooklyn shore, has a width of 0.76 mile, or 4036 feet, a maximum depth of 38 feet at low water, and an area of 19.88 per cent of the total area, which latter

is 380,466 square feet. The entire width of the section is 24,214 feet, or 4.58 miles, and the average depth at low water is 15.71 feet. The average depths at low water of the said three parts are respectively 5.22, 32.07 and 18.74 feet, and the corresponding sectional areas are respectively 66,496, 238,336 and 75,634 square feet.

It will also be seen from this exhibit that the said group of sewage outlets is located in the second part of the said section near Robbins Reef Light, and on a bottom sloping to the deepest channel. This channel is about 2350 feet wide at a depth of 40 feet, and 3190 feet wide at a depth of 30 feet below low water surface. From a point about one mile north of Robbins Reef Light, the course of this deep channel is a curve, convex to the west, extending southerly to the Narrows, but its depth is by no means uniform, as is shown in the following table which is derived from scale measurements to points of deepest soundings shown on Complainants' Exhibit Nos. 171 and 171-A.

3983 *Table Showing Profile of Botton of Upper New York Bay Along the Line of Greatest Depth Below Low Water Surface, Beginning at the Mouth of the Hudson River Opposite Battery Point in Borough of Manhattan, and Ending 0.94 Mile South of the Narrows or Line from Fort Wadsworth to Fort Lafayette.*

Point No.	Distance from mouth of Hudson river		Greatest depth below low water surface, Feet.	Point No.	Distance from mouth of Hudson river.		Greatest depth below low water surface, Feet.
	Feet.	Miles.			Feet.	Miles.	
0.....	0.0	0.0	50	21.....	22,000	4.28	50
1.....	700	0.13	50	†22.....	23,900	4.53	61
2.....	1,700	0.32	60	23.....	25,200	4.77	61
3.....	3,000	0.57	87	24.....	26,700	5.06	57
4.....	3,700	0.70	93	25.....	28,400	5.38	55
5.....	4,900	0.92	86	26.....	29,400	5.56	55
6.....	5,900	1.12	83	27.....	30,600	5.80	58
7.....	7,400	1.40	65	28.....	31,300	5.93	63
8.....	8,400	1.59	74	29.....	31,900	6.05	69
9.....	9,600	1.81	60	30.....	32,700	6.19	76
10.....	10,900	2.07	56	31.....	33,500	6.34	77
11.....	12,700	2.41	56	32.....	34,300	6.50	78
12.....	13,500	2.55	53	33.....	35,300	6.68	75
13.....	14,500	2.74	59	34.....	37,000	7.00	80
14.....	15,800	3.00	60	35.....	38,000	7.19	90
15.....	17,200	3.25	70	†36.....	38,800	7.36	94
16.....	18,500	3.50	75	37.....	39,200	7.42	96
17.....	19,300	3.66	71	38.....	40,400	7.64	101
*18.....	19,900	3.77	66	39.....	41,700	7.90	107
19.....	20,500	3.88	60	40.....	42,900	8.12	109
20.....	21,500	4.07	46	41.....	43,900	8.30	116

NOTE.—* Denotes point of intersection with section line through Robbins Reef Light.

† Denotes point of intersection with deep channel of Kill Van Kull.

3984 ‡ Denotes point of intersection with line from Fort Wadsworth to Fort Lafayette.

The foregoing table shows that in the distance of 4.53 miles from the mouth of the Hudson River to Kill Van Kull, the maximum channel depth ranges from 93 to 46 feet, with an average of 64.2 feet; and that in the distance of 2.83 miles from Kill Van Kull to the Narrows at Fort Lafayette, it ranges from 55 to 94 feet, with an average of 70.2 feet; also that in the entire distance of 7.36 miles from the mouth of the Hudson River to the Narrows at Fort Lafayette, it ranges from 46 to 94 feet, with an average of 66.0 feet. It may also be stated that the width of the Upper Bay varies greatly, as follows:—just below Battery Point, 1.91 miles; from Red Hook to Communipaw, 2.74 miles; from Bayonne through Robbins Reef Light to northern part of Bay Ridge, Brooklyn, 4.59 miles; from Tomkinsville, Staten Island to Bay Ridge, 1.94 miles; from Stapleton, Staten Island, to southern part of Bay Ridge, 1.78 miles; at Narrows, 0.99 mile. The area of the Upper Bay is 20.74 square miles; its length in a straight line from Battery Point to the Narrows is 7.00 miles, and its average width is thus 2.96 miles.

Besides the aforesaid great variations in both width and depth of Upper New York Bay, further complications are introduced by the flow from the Hudson and East Rivers and the Kill Van Kull, or Newark Bay.

In my previous testimony I called attention to the surface currents and drifts that take place in Upper New York Bay, and to the fact that the strongest currents are found in the principal channel which is characterized by the greatest depth of water, and which I have more fully described a few minutes ago. The sewage of the Passaic

Valley District discharged into this principal channel in the 3985 manner previously described, will be carried along by the strong tidal currents without much diffusion after rising to the surface, and will form a relatively narrow belt, field or area, which will oscillate with the tides from 8 to 10 miles from Robbins Reef Light up and down the Bay in calm weather. The numerous experiments made with floats by the United States Coast and Geodetic Survey and the Metropolitan Sewerage Commission of New York indicate clearly that a floating particle of matter placed in the principal channel near Robbins Reef Light, will thus oscillate back and forth for at least two or three tidal periods, or from 25 to 38 hours, before it remains permanently in the Lower Bay, or below the Narrows; also that under less favorable conditions, it will return to a point above the Narrows during a much greater number of tidal periods and hours. On the average such a particle will oscillate back and forth in the Upper Bay about three days in calm weather.

What I have just said about a floating particle in the principal channel of Upper New York Bay, can also be applied to the sewage proposed to be discharged near Robbins Reef Light, but in this case the gradual diffusion of the sewage into the salt water of the Bay must be taken into account. I stated previously that the 150 sewage outlets planned by the Passaic Valley Sewerage Commission are located in an area of about 2½ acres, which is about 505 feet long and 205 feet wide on the average, on the west side of the said principal channel of the Upper Bay, where the water is not less

than 40 feet deep at low tide. With allowance for initial diffusion the width of the area may be considered to be 300 feet and its length 600 feet, so that if the water over said area were stationary its volume would be 7,200,000 cubic feet. Into this volume the sewage will flow at the rate of 360,000,000 gallons per day or 557 cubic feet per second. If the water were stationary for one hour at the turn of the tide, it would thus be mixed with about 2,000,000 cubic feet of sewage. It is claimed in Defendants' Exhibit No. 5, however, that the water of the Bay in said locality is never wholly quiescent at the turn of the tide, but that the lower two thirds of said volume has an average motion of about one 3986 quarter foot per second, while the upper third is temporarily stationary. This is due to the fact that the currents do not reverse simultaneously in all parts of a cross section of the channel.

Accepting these figures for the under-current at slack water or turn of tide as correct, and that the duration of slack water is 30 minutes, then the prism of water that would be polluted by one half hour's discharge of sewage, or 1,000,000 cubic feet, is 300 feet x 1050 feet x 40 feet = 12,600,000 cubic feet, so that if the Bay water were clean the sewage would be diluted 12.6 fold. This makes a ratio of one part of sewage to 12.6 parts of clean water. At the end of the said half hour, however, this same volume will return and be dosed a second time with sewage, whereby the dilution would become only half as much, or about 6.3 fold, or 1 part of sewage to 6.3 parts of clean water. A similar action occurs at the next turn of tide, and so on for from 3 to 6 or more tidal periods, until the volume of water that has been dosed repeatedly with sewage remains permanently below the Narrows, or becomes purified by slow natural processes. It is therefore obvious that in calm weather the sewage will not become mingled with the entire tidal volume of water passing through the Bay, but will be mixed with only a very small fraction of the tidal flow in each tidal period.

Mr. H. De B. Parsons has testified in Complainants' Exhibit No. 91 in this suit, that the total average ebb flow through the Narrows is 12,040,000,000 cubic feet during a period of 6.7 lunar hours, or 6.935 solar hours, and that the total average flood flow through the Narrows is 10,780,000,000 cubic feet during a period of 5.3 lunar hours, or 5.486 solar hours. By reducing to the average rate of flow per second, these figures become respectively 482,200 and 545,800 cubic feet per second, while the proposed rate of sewage discharge from the Passaic Valley Sewer District in 1940 is 557 cubic feet per second; but a comparison between these figures cannot be made to ascertain the extent to which the said sewage will

be diluted with Bay water, for the reasons previously given 3987 by me. An approximation to the average rate of dilution during a tidal period may be obtained by estimating the mean velocity of the tidal current at the locality under consideration, and applying this velocity to the aforesaid prism of Bay water lying above the said sewage outlets. Assuming such velocity at 1.0 feet per second, and the sectional area at 300 feet x 40 feet

= 12,000 square feet, the initial dilution will become $\frac{12000}{557} = 21.5$

fold, but this will quickly be reduced by repeated dosing as the water oscillates back and forth over the sewage outlets.

The subject of the dilution of the sewage deserved particular attention because most of the witnesses for the defense have referred to the large volume of tidal flow through the Narrows from and into Upper New York Bay, and compared it with the relatively small volume of sewage proposed to be discharged during the tidal periods. They have also assumed tacitly that the mixture of the sewage with the entire volume of flowing tidal water takes place very rapidly or instantaneously, whereas the process of diffusion of sewage in brackish water is actually accomplished very slowly, as shown by the observation of sewage fields in salty waters. It can be presumed that with these erroneous premises as to diffusion, they easily reached the conclusion that the dilution of the sewage would always be extremely great, and hence that no nuisance in Upper New York Bay would ever result from the proposed discharge of the sewage of the Passaic Valley District. The true facts to be borne in mind are: 1. That the sewage diffuses very slowly in the brackish water; 2. That the sewage tends to float on the top of the brackish water; 3. That the experiments made with colored fresh water discharged into the brackish Bay water in the vicinity of Robbins Reef Light tend to establish the two preceding facts; 4. That the same volume of Bay water which comes into immediate contact with the said sewage at any moment of time is repeatedly exposed to such contact in consequence of the oscillatory tidal motion of the water over the sewage outlets; and 5, that such oscillation may range from 5 to 12 or more before the initially polluted body of water remains permanently below the Narrows.

Q. Have you studied the details of Mr. G. A. Johnson's experiments made with dyed water on November 19th, 1907, and if so, state with what results?

Mr. Riker: The question is objected to as not being in rebuttal of any specific testimony offered on the part of the defense.

The Commissioner: Note the objection of Counsel for Defendants.

A. In his testimony given on February 13, 1913, for the Defendants for the Defendants in this suit, Mr. George A. Johnson described a series of four experiments with dyed fresh water which he discharged on November 19, 1907, at depths of 10, 20, 30 and 40 feet into the waters of Upper New York Bay at a point about $\frac{5}{8}$ mile northeast of Robbins Reef Light. He stated that the discharges at depths of 10 and 20 feet appeared soon on the surface of the Bay, while those at depths of 30 and 40 feet did not appear on the surface. From this he expressed the conclusion (on page 3982 of the testimony) that if the freshwater sewage of the Passaic Valley District were discharged in the manner proposed at a depth of not less than 404 feet below the surface of the Bay, it would undergo sufficiently complete diffusion in the waters so as not to rise to the surface in objectionable quantity, if at all, and rarely

invisible quantities. In my opinion this conclusion is not warranted by the data submitted by Mr. Johnson. The point where the said experiments of November 19, 1907, were made is not near the point which has been selected for the discharge of the sewage of the Passaic Valley District, but is more than $\frac{3}{8}$ mile north of the latter. Furthermore, in each experiment the dyed fresh water was discharged vertically downward through a 6 inch pipe having a sectional area of 0.200 square feet, with velocities of from 9 to 10 feet per second and at rates of from 1.8 to 2.0 cubic feet per second, during brief periods of time ranging from only 6 to 16 minutes. On the other hand, the said sewage is proposed to be discharged vertically upwards and continuously from 150
3989 conical annular outlets, each 24 inches in diameter and 2 inches wide with a sectional area of 1.13 square feet, a velocity of 3.27 feet per second, and a delivery of 3.71 cubic feet per second when the total daily discharge of sewage is 360,000,000 gallons, or 557 cubic feet per second. A little reflection suffices to prove that the conditions of the said short experiments are not comparable with those that will ensue if the continual discharge of sewage is permitted. The tidal currents at the locality are constantly changing in both direction and intensity, and are at times stronger at the bottom than at the surface. They are also affected by the wind and the seasonal discharges of the Hudson River. In November 1907, the flow of this River attained its maximum for that month, and was more than twice its average flow during November from 1891 to 1908 inclusive, and nearly eight times its minimum flow in November, 1908; so that when said experiments were made the salinity of the water of the Bay was considerably lower than usual in this month, thereby making the specific gravity of the dyed water more nearly equal to that of the Bay water and retarding its tendency to rise to the surface of the brackish water. The greater flow of the river in said month also tended to prolong the duration of ebb currents, and to modify the action of the under-run currents appreciably. The record of Mr. Johnson's experiments on November 19, 1907, should also have included a statement as to the condition of the weather on that day. I have examined the official records of the United States Weather Bureau for said day in the City of New York, and find therefrom that it was foggy from 5 A. M. to 9 A. M. and cloudy during most of the remainder of the day; that from 12 M to 4 P. M. the wind was blowing from the northwest with a velocity of from 11 to 16 miles per hour, which was sufficient to have caused the surface water in the Bay to be rough and to drift southeasterly towards the Brooklyn shore; that the temperature of the air from 12 M to 4 P. M.
ranged from 50 degrees Fahrenheit to 54 degrees Fahrenheit,
3990 heit, and that on the preceding day it reached a minimum of 39 degrees Fahrenheit, also that from 11:40 A. M. of November 18 to 4 A. M. of November 19, 0.79 inch of rain fell. The temperature of the water on said day was not mentioned by Mr. Johnson, but in November 1909, it was found to range at Robbins Reef Light from 54 degrees Fahrenheit to 46 degrees Fahrenheit, as given in the testimony of Mr. H. De B. Parsons in

this suit. As the dyed water used by Mr. Johnson was prepared on November 18 and remained exposed to a low temperature over night, it may be inferred that on November 19 it was somewhat cooler than the Bay water, whereby its specific gravity approaches that of the latter, and its tendency to rise through the latter was correspondingly reduced on being discharged.

The various physical conditions on November 19, 1907, which I have just described, were in my opinion such as to render it very difficult to perform delicate experiments in the Bay at Robbins Reef, and to obtain therefrom results that would be sufficiently trustworthy to warrant the broad conclusion expressed by Mr. Johnson. A further reason for objecting to said conclusion is that the latter does not appear to be founded on a thorough knowledge of the complex tidal currents in the vicinity of Robbins Reef Light. The data given by Mr. Johnson relating to the direction and intensity of the currents below the surface of the water during the time of his said experiments on November 19, 1907, are very incomplete and indefinite. They represent merely the observations of the pull and general direction of the upper part of a thick cord attached to a deeply submerged receptacle for taking samples of water. They indicate only that the bottom velocity is strong or slight when the surface current is strong or slight and in the same direction; and they differ in this respect from the far more accurate observations made by the United States Coast Survey in 1858 and 1859, cited by Mr. Johnson on page 3977 of the testimony, which show that at Robbins Reef Light slack water at the bottom of the main deep channel occurred two or three hours before low slack water occurred at the surface, whereas Mr. Johnson's data on page 3978 tend to show that the motion of the water at the bottom stops at about the same time that it stops on the surface.

I have also examined closely the published Reports of the Superintendent of the United States Coast Survey for the year 1858 and 1859, but was unable to find in Appendix 8 thereof anything but a general list of items of work performed by this Department. On page 38 of the said Report for 1858, the following statement is made: "At a station between Governor's and Bedloe's Islands, the currents were observed at the surface and at 17, 42 and 68 feet depth, respectively, the depth of water at the station being 80 feet. The flood drift, or current, at 42 feet and still more at 68 feet, greatly exceeds that at the surface in velocity and duration, while the ebb drift at 68 feet is very feeble, that at 42 feet being still considerable. During the course of the tide, the axis of the drift or line of greatest movement, changes its place considerably, rising or sinking." In Appendix No. 28 of the said Report, pp. 204-207, Mr. Henry Mitchell describes briefly the tidal currents in the East River and Upper New York Bay, the essential features being set forth as follows: "We have ascertained that, instead of uniform graduation of velocities from surface to bottom, there often occurs in deep channels a counter-drift, or even distinct streams,

at different depths. These singular movements were ascertained to belong to certain localities only in New York Harbor, where they assume sometimes the forms of immense rotatory movements in vertical planes. At some of our stations phenomena of this character never fail to repeat themselves daily, on the recurrence of certain tidal phases, while at others the wind enters in as an element and varies the conditions. At certain stations we found that when the surface current is opposed by strong winds, the axis of the stream sinks, and the water pours on below the retarded stratum. * * * From the most hasty consideration of our results, it may be seen that without a knowledge of these sub-currents, structures however simple, placed in New York Harbor, may be productive of the most disastrous consequences, by controlling in a degree the future movements of the shoals, or by causing new deposits."

A somewhat longer description of the tidal currents in New York Harbor is given by Mr. Henry Mitchell in Appendix No. 15, pp. 301-311 of the Report of the Superintendent of the United States Coast and Geodetic Survey for 1887. In this document sketches of the under-run at the last stage of flood and ebb are given, showing the positions of inclined strata of water of different density or salinity in different parts of the harbor from the Lower Bay to the Tappan Sea. It also contains a number of diagrams showing how the velocity varies from the surface to the bottom at a number of points, but none of these are in the vicinity of Robbins Reef Light. It also appears from my examinations that Mr. Mitchell's original report on the subject was never published in full by the Superintendent of the United States Coast and Geodetic Survey, and that general references thereto appear only in the Reports of 1858, 1859, 1863 and 1887.

The quotations I have just made indicate that the tidal currents in Upper New York Bay are very complex in character, and the fact that a full report on them has not yet been issued by the United States Coast and Geodetic Survey can be regarded as evidence that they are still under study. Some of the difficulties of the problem will appear by examining the profile of the bottom of this bay shown on Complainants' Exhibit No. 205. The most significant feature of this profile is the prominence or peak marked A somewhat south of Robbins Reef Light. At low water the depth is here only 46 feet, whereas 3,200 feet northerly the depth is 75 feet at the point marked B, and 3,000 feet southerly it is 60 feet at the point marked

C. The effect of this peak A is manifestly to deflect the lowest stratum of water polluted by the sewage near Robbins Reef Light upwards during ebb, thus tending to bring it to the surface in the vicinity of the Kill Van Kull, or the Point C; while during flood tide, the lowest stratum of heavier salt water entering from the lower Bay is also deflected upwards, and tends to reach the surface in the vicinity of the point B, where it will gradually settle down through the lighter brackish water unless its weight is reduced by admixture with the said sewage. In both cases the polluted water will tend to remain at the surface.

Referring again to the aforesaid experiments on November 19, 1907, Mr. Johnson stated that the Government had predicted that low water would occur at Robbins Reef Light at 12:45 P. M. on that day. I have been unable to find this particular prediction in the "Tide Tables" published by the United States Coast and Geodetic Survey, but found in said tables for 1907 that low water would occur at Governors Island at 1:57 P. M. on said day. I also found on a diagram of tidal periods and currents for New York Harbor on page 481 of Tide Tables for 1907 and page 489 of Tide Tables for 1912, published by the United States Coast and Geodetic Survey, that low water at Robbins Reef Light occurs normally about 12 minutes before it occurs at Governors Island, so that on November 19, 1907, low water should have been expected at Robbins Reef Light, at 1:45 P. M. or one hour after the time stated by Mr. Johnson. In order to ascertain the actual time that low water occurred on said day, I examined the chart or automatic mechanical record for November 19, 1907, of the standard tide gage maintained at the Battery by the Dock Department of New York City. These records are preserved in the office of said Department on Pier A, Hudson River, and I found that low water on said day was indicated at about 2:25 P. M. The distance from the Battery south to Governors Island is only 0.71 miles, and the difference in time between the occurrence of low water at the two places has been found to be very small or practically inappreciable hence it can be concluded
3994 that on said day low water at Robbins Reef Light actually occurred about 2:10 P. M.

It is also shown by the aforesaid diagram in Tide Tables for 1907 and 1912, that slack low water at Robbins Reef Light normally occurs 2.5 hours after low water at Governors Island. This reckoning would make slack low water at Robbins Reef Light on November 19, 1907, occur at about 4:50 P. M. whereas, according to Mr. Johnson's data, it occurred at 2:30 P. M. A similar discrepancy is found in the time of occurrence of slack water, or stoppage of motion, at the bottom, if the said hour (2:30 P. M.) given by Mr. Johnson for slack low water at the surface is correct. According to the observations of the United States Coast Survey cited by Mr. Johnson on page 3977 of the testimony, slack water at the bottom occurs 2 or 3 hours before it occurs on the surface, so that on said day there would have been no motion at the bottom at from 11:30 A. M. to 12:30 P. M. whereas Mr. Johnson states that there was a strong bottom current in a southerly direction at 1:00 and 1:10 P. M., and that slack water at the bottom occurred between 1:40 and 2:40 P. M. These incongruities lead to the alternative inferences that either some errors in regard to time were made on November 19, 1907, or that the tidal currents on the surface and bottom at Robbins Reef Light had not been studied closely by Mr. Johnson at the time that he drew his conclusion as to the improbability of any of the sewage of the Passaic Valley District rising to the surface if discharged at a depth of 40 feet in the vicinity of Robbins Reef Light. This particular feature is the essential element of the project under consideration, and it is very evident that

in view of the great complexity of the tidal currents in New York Harbor, as set forth by the United States Coast and Geodetic Survey, many other experiments lasting much longer than two hours should have been made at the contemplated point of discharging an enormous volume of sewage before expressing the vital conclusion mentioned.

Q. In your opinion will offensive odors be developed in 3995 the vicinity of Robbins Reef Light if the sewage of the Passaic Valley District is discharged in the manner proposed by the Passaic Valley Sewerage Commission?

Mr. Riker: Same objection as not being rebuttal and not being directed to any specific testimony offered on behalf of the defense, being matters already testified to by this witness in his main case.

The Commissioner: Note the objection of Counsel for the Defendants.

A. In view of the great length of the proposed Passaic Valley trunk sewer and outlet tunnel, and the long time that must elapse between the production of the sewage and trade wastes at their point of origin and their final discharge into Upper New York Bay near Robbins Reef Light, there can be no doubt as to the offensiveness of the odors from the proposed effluent as it will be discharged into the Bay in warm weather. No provision for deodorizing this effluent appears to have been made. From many observations in American cities, the temperature of the sewage in summer reaches and exceeds 70 degrees Fahrenheit, whereby fermentation becomes very active, and as the time of flow from point of origin to the Bay is from 8 to 16 hours in the case of the sewage under consideration, the liquid will certainly acquire a strongly offensive odor.

It must be remembered that salty or brackish water does not absorb and retain gases and volatile substances to the same extent as fresh water, and that when malodorous sewage is mixed with sea water the offensive odors are quickly liberated and seem to be aggravated in intensity. I have noticed this peculiarity at many sewer outlets into salt waters and have made special experiments with samples of the same foul sewage placed in quart jars containing sea water and fresh water separately. In every instance the odor from the jar filled with sea water soon became much stronger and more offensive than that from the jar filled with fresh water. This took place long before the mixtures began to ferment actively, and in warm weather the odor from the mixture with sea water 3996 intensified greatly within 24 hours. The same action has also been observed recently by the various experts who investigated the expediency of building a dam across the Charles River near Craigie Bridge in Boston, Massachusetts, as set forth in the elaborate Report of the Committee published in 1903, and also by Professors W. E. Adeney and E. A. Letts in Appendix VI of the Fifth Report of the Royal Commission on Sewage Disposal, London, 1908.

In the said Report of the Committee on the Charles River Dam, (Boston, 1903) Mr. H. W. Clark, Chemist of the Massachusetts

State Board of Health, states on pages 271 and 272 that as salt water holds less oxygen in solution than an equal volume of fresh water, the latter can receive more pollution, and that the odors from mixtures of salt water and sewage grew worse with time. He also states that the mud flats or bottoms of a salt water basin give off much more offensive odors than the mud bottoms of a fresh water basin. On page 291 he writes that there is the constant tendency for the precipitation of the organic matter or sewage to occur in salt water, and hence for the concentration of this matter in the form of putrefying sludge deposits; and on page 280 he mentions that the action of such sludge in exhausting dissolved oxygen from the water is far more intense than that of mud, since "one-tenth as much by weight of dried sewage sludge as of the muds used in these experiments, exhausts oxygen under similar conditions as provided by many tests."

In the same investigation the biologist, Dr. G. W. Field, found from his observations and experiments that sewage in fresh water was less offensive than in an equal volume of salt or brackish water. Uniform salinity cannot be maintained in a salt water basin, and sudden changes of salinity are fatal to many low forms of aquatic life by which the reduction or transformation of sewage matters is effected. On page 316 he states that the introduction of salt water into a fresh water basin should be avoided, as the plasmolysis resulting from the contact of the salt water with the delicate fresh water organisms will probably cause their death. All of these expert investigations were carefully reviewed by the engineer of the Committee, Mr. John R. Freeman, who adds on page 81 that "a marked difference is noted in the odors arising from the manholes of the Boston main drainage and Metropolitan sewers to which some proportion of salt water has been admitted, in comparison with the manholes of the common sewers that receive no salt water," the inference being clearly that the odors from the former set of man-holes are worse or stronger than those from the latter. It may also be noted that in his recent book on "Sewage Disposal" New York, 1912, Mr. George W. Fuller, of New York City, commends these investigations as being the best on the subject that have yet been undertaken.

In the aforesaid Appendix VI of the Fifth Report of the Royal Commission on Sewage Disposal, Professors Adeney and Letts state on page 437 that "there seems to be a wide-spread impression that the odors from over-polluted sea water are more offensive than those from over-polluted fresh water. This impression is probably well founded, since sulphides, and possibly organic sulphur compounds, are formed in sea water, when over-polluted, by the reduction of its sulphates." This peculiar reduction is discussed in detail on page 120 of said volume, and is attributed to a specific anaerobic organism called "microspira or spirillum desulphuricans," which occurs abundantly in sewage during July, August and September. Sulphuretted hydrogen is produced in this action (p. 122) because the combustion (or oxidation) of the organic matter supplies the energy necessary for reducing sulphates to sulphides; consequently there

should be a definite relation between the amount of carbonic anhydride (or carbon dioxide) and sulphuretted hydrogen evolved, the former deriving its oxygen from the sulphate reduced. Thus in a culture medium containing no other organic matter than sodium lactate, the eventual chemical change must be such as to yield two molecules of carbonic anhydride, either free or combined for every molecule of sulphuretted hydrogen formed.

The researches of Van Delden and Beyerink indicate that the bulk of the sulphuretted hydrogen occurring in both foul sewage and certain mud banks, owes its origin rather to sulphates than to albuminoid bodies, but they did not investigate experimentally the important rôle played by the ferrous sulphide which is chiefly in evidence in foul deposits. The action of this sulphide was recently investigated by Mr. J. L. McKee, as stated in said Appendix, pages 122-125, and the experiments showed that it was readily decomposed by carbonic acid with liberation of enough sulphuretted hydrogen to cause a serious nuisance. It was also found that ferrous sulphide is decomposed by fatty acids, such as butyric acid, with copious evolution of sulphuretted hydrogen.

In regard to the exact nature of the objectionable odors of sewage and its products of decomposition, comparatively little appears to be definitely known. These odors are associated alike with gases, substances in solution and solids. An excellent discussion of them is given on pages 86 to 99 of Mr. George W. Fuller's aforesaid book on "Sewage Disposal," in which it is stated that while sulphuretted hydrogen has had the reputation of being the most offensive product, yet the correctness of this is doubtful. Indol, skatol, cadaverin, mercaptan, phosphine and some other compounds are likewise found in both fresh and septic sewage, and are all considered much more repulsive than pure sulphuretted hydrogen. Indol and skatol are always found in fresh feces, and show themselves at times in sewers and sewage disposal works. With the exception of sulphuretted hydrogen, all of the substances mentioned are found in sewage only in a soluble non-gaseous state, and make themselves felt by volatilization or evaporation. The gaseous products of sewage decomposition are hydrogen, nitrogen, methane (CH_4), carbonic acid (CO_2), ammonia (NH_3), phosphine (PH_3), and sulphuretted hydrogen (H_2S). It may also be added that odors emanate from solutions of gases and solids far below the point of saturation.

In the second edition of Lafar's "Manual of Technical Mycology" (Jena, 1906), Volume 3, page 85, the subject of the putrefaction of protein is ably discussed by Drs. Hahn and Spieckermann. It is there stated that when air (or oxygen) is partially or wholly excluded from dead vegetable or animal matter, the process called putrefaction ensues and is accompanied by the plentiful evolution of offensive odors. In the case of animal matter, proteid and gelatinous or albuminous substances predominate, and carbohydrates occupy a secondary position. The former class of substances, however, contain much sulphur and nitrogen, and hence their putrefaction is marked by the formation of basic compounds

of nitrogen and offensive volatile compounds of sulphur. In the case of vegetable matter, on the other hand, carbohydrates usually predominate to great extent, and its putrefaction involves the formation of certain acids and gases whose odors are much less pungent and repulsive; but when the vegetable matter approximates animal matter in composition, such as grains or seeds rich in portein, its putrefaction proceeds in nearly the same manner as that of animal matter.

From the foregoing facts I reach the conclusion that in calm and warm weather, an extensive dilution or admixture of the sewage with the tidal water of Upper New York Bay will not take place; also that this sewage will have an offensive odor and that this odor will be liberated soon after such admixture and will create an unmistakable nuisance in the vicinity of Robbins Reef Light; and that such odor nuisance will be carried by light winds to the shores of Upper New York Bay. In reaching this conclusion I take into account the further fact that the waters of Upper New York Bay can never become pure and saturated with dissolved oxygen, owing to the unavoidable pollution brought into them by the washings of the densely populated tributary watershed during heavy rain-falls, even if all the sewage proper of this watershed were treated in the manner proposed by the Passaic Valley Sewerage Commission and discharged elsewhere.

4000 From a practical point of view, it cannot be expected that the waters of Upper New York Bay will ever attain the same degree of purity that they had 50 years ago; and therefore, in considering the disposal of sewage by dilution, it must be borne in mind that in this particular case the diluting brackish water of the Bay is widely different in quality from that of large unpolluted rivers and great lakes. It may also be added that the testimony offered by the defendants in this suit does not contain any data from which any other conclusions than those just expressed by me can be reached.

Q. In your opinion, will the proposed effluent of the sewage of the Passaic Valley District contain visible particles of suspended matter, and will such particles be visible in the waters of Upper New York Bay in the vicinity of Robbins Reef Light?

Mr. Riker: Same objection as to the last question.

The Commissioner: Note the objection of Counsel for the defendants.

A. The matters carried in suspension in sewage are generally grouped into three classes, viz: 1, the lighter solids that always float on the surface of the liquid; 2, the solids that have approximately the same specific gravity as the liquid and are distributed throughout its entire volume without settling to the bottom while the liquid is moving at velocities of more than 1.5 feet per second; and 3, the solids that are much heavier than water, and which are carried along on the bottom of the sewer by the current, but do not mingle extensively with the bulk of the liquid. The second class embraces the semi-liquid substances known as colloidal mat-

ters, as well as the finely-divided solids or minute particles which will not settle within a period of several hours to the bottom of a tank wherein the sewage is kept in an approximately quiescent state. As the term "colloidal matter" is often used loosely in speaking of sewage, it will be of interest to describe such matter more definitely, especially as it is frequently classed with the matters found in solution. Thus is a paper on the subject by Dr. J. H. Johnson, in the *Journal of the Royal Sanitary Institute of England*, Vol. 27, (1906), page 55, it is stated that about one half of the dissolved organic matter in sewage is in colloidal solution; and in another paper on page 433 of the same volume, Messrs. Purvis and Coleman refer to certain colloidal matter in sewage as being highly complex nitrogenous compounds, which remained held in solution at the end of 8 weeks of observation.

Substances are usually regarded as colloidal which swell up into a gelatinous mass when water is added to them. Gelatine, glue, starch, paste, agar, etc. are such colloids and exhibit their character when their temperature is reduced. Soaps and emulsions of fat and oils are also typical colloids. Many mineral compounds possess the same property, as when sodium silicate is mixed with hydrochloric acid, whereby a voluminous gelatinous precipitate of silicic acid is formed. Similar precipitates are the hydroxides of iron and aluminum, certain acids of tin and wolfram, sulphide of arsenic, and numerous others which can be removed from dilute aqueous solutions by dialysis. The very fine silt carried along by large rivers also contains much colloidal silica in combination with potash, nitrogen and phosphoric acid derived from the water.

The protoplasm of plants and animals consists essentially of albuminous matter. Many albuminous substances of animal origin, such as white of egg and blood serum, form colloidal solutions in fresh water, while others like the globulins become soluble on adding sodium chloride, or in sea water, and still others, such as casein and certain artificial alkaline albuminates, require the addition of basic alkaline salts. All of these colloidal solutions will be retained on a dialyzing membrane, and can be precipitated as gelatinous masses under various conditions of coagulation or peptisation. Vegetable albumens are formed in all plants and are also found in the seeds.

They resemble animal albumens by being coagulated by heat and various chemical reagents; they are also digested and show the same chemical relations and general composition, but it has not yet been proved that these two albumens are identical.

By the processes of putrefaction and fermentation, albumens are reduced to fatty acids and odorous combinations like phenyl-propionic acid, skatol-acetic acid, phenols, indol and skatol, and various ptomaines or toxins are also produced thereby. Proteids are first attacked by transient aerobic changes, such as ammonia and urea; next to anaerobic organisms, and lastly by oxygen and nitrification. The chemical composition of these albumens shows that they contain from 50 to 55 per cent. carbon, 15 to 19 per cent. nitrogen, 19 to 24 per cent. oxygen, 6.6 to 7.3 per cent. hydrogen,

0.4 to 5.0 per cent. sulphur, with small amounts of phosphorus and iron. Glue-like substances are the products of the incipient oxidation and reduction of albumen in the bodies of animals, and are the chief component of connective tissue, gristle and cartilage. They differ from albumen by containing less carbon and being solid instead of liquid. Fats are reduced much more slowly than the proteids or albumens, and in sewage they must emulsify before they can be acted on by bacteria. Experience has demonstrated that sewage containing much fatty matter is far more difficult to treat than that in which the suspended matter consists mostly of proteids and carbohydrates. The fats are generally compounds of alcohol, glycerol and fatty acids such as stearic, palmitic and oleic acid, and the most important of these compounds are called stearine, palmitine, oleine and butyrine. Most animal fats are mixtures of two or more of these substances in different proportions, and they consist of carbon, hydrogen and oxygen.

Carbohydrates embrace a large number of substances which are represented by starches, sugars, cellulose and wood fibre. The sugars are perfectly soluble in water, and are changed by fermentation into alcohol. The starches and some kinds of cellulose are converted into sugars by weak acids and certain ferments, but other kinds of cellulose and wood fibre are highly resistant and undergo decomposition by ferments in sewage tanks very slowly.

Most colloidal matter is developed in the economy of mankind and domestic animals, in the form of excretions and degenerations of cellular structures, especially those of the epithelial type. These cells become swollen by a translucent gelatinous semi-liquid substance, and are thrown off, whereupon they fuse together and form colloid masses. The gelatinous mucin which is normally secreted by the epithelial cells of the mucous membranes and glands is also colloidal, and in certain diseases of the elementary tract this mucoid matter infiltrates into the surrounding tissues forming the so-called "colloid cancer."

Colloidal matter is characteristic of the widely diversified groups of textile fibres. It has a wide range of cohesion, elasticity, and extensibility and in the form of cellulose and some other substances it maintains these characteristics throughout a cycle of transformations whereby it is brought into soluble plastic form, in which condition it can be drawn out into continuous filaments of indefinite length. The artificial silks or lustra celluloses are produced in this way, and have obtained a position as staple textiles.

The animal fibres are composed of nitrogenous colloids which are typically represented by albumens, fibrines and gelatines. They are of highly complex chemical constitution, and their characteristics have been only generally investigated. The vegetable fibre substances are celluloses and derivations thereof which are also typical colloids. The broad distinction between these two groups of fibres is chiefly evident in their relation to alkalis. The animal group is attacked and finally dissolved by alkalis under conditions of action by no means severe, whereas the celluloses and vegetable fibres are

extraordinarily resistant to such action. In general it may be said that all animal fibres will be dissolved in a 10 per cent. solution of caustic potash, and that wool is distinguished from silk by its relative resistance of sulphuric acid. The cold concentrated acid 4004 rapidly dissolves silk and vegetable fibres, but attacks wool slowly.

The animal fibres are comparatively few in number, but of great industrial importance. They occur in detached units and of varying length; sheep's wool has lengths up to 36 inches and horse hair up to 24 inches, while silks have a length of hundreds of yards. The vegetable fibres are extremely numerous and of very diversified characteristics. They are individualized units only in the case of seed hairs, of which cotton is the most important. With this exception they are elaborated as more or less complex aggregates such as the bast tissues that furnish such staples as flax, hemp, ramie and jute. In the process preparatory to spinning, the fibre aggregates are more or less subdivided. In this group are included the woods that furnish pulps of various grades, and which are resolved by acid and alkaline chemical means.

The organic matter in sewage consists chiefly of urea, proteids or albumens, carbohydrates, fats and soaps, all of which are more or less soluble in fresh water and colloidal in character, as already mentioned. These substances are also putrescible, and when caused to settle in a sewage tank the process of putrefaction will soon begin, or will progress rapidly if it has started previously while flowing in the sewer. From what I have said in the foregoing, it is evident that many industrial wastes which are usually discharged into the sewers of a city contain much putrescible organic matter of colloidal character, and long experience has shown that a large proportion of it is difficult to treat in a satisfactory manner. This is particularly true of the wastes from tanneries, abattoirs, sugar works and cellulose factories.

Most of the recent technical literature on the subject of sewage purification recognizes the necessity of securing the most complete removal of the suspended solid and colloidal matters before applying the final oxidation processes to the effluent containing the 4005 fully dissolved organic substances; and some authors insist that clarification is essentially the result of purely physical operations, and that bacteria play only a subsidiary part in the purification process. Hitherto little seems to be known about the best means of arresting and precipitating or depositing the colloidal substances which constitute so large a proportion of the soluble organic matter. In 1905 Dr. G. J. Fowler and Mr. E. Arden recorded in the "Journal of the Society of Chemical Industry," Volume 25 page 483, certain observations they had made about organic matters in emulsion or colloidal form in the sewage of Manchester, England. They showed that such matter was about 60 per cent. of the oxidizable matter, and about 76 per cent. of the albuminoid nitrogen; also that in domestic sewage the percentage was somewhat higher. Their experiments indicated that the proportion of colloidal matter in the effluent from the Manchester septic tank was

about the same as in the septic sewage. In the filtered sewage 50 per cent. of its contents of albuminoid nitrogen came from matter in colloidal solution, and in the case of the filtered effluent from the septic tank about 47.5 per cent. was in such solution. They also found that if the said tank effluent was allowed to stand, large quantities of organic matter would settle on the bottom, and that deposits would form even when this effluent was first filtered through paper. It therefore follows that the quantity of soluble colloidal substance present in the sewage in pseudo-solution or emulsion represents potentially suspended matter and should be treated as such.

In reporting sewage analyses, it has been customary to regard all matter that passes through ordinary filter paper as being in true solution, but it is a fact that the liquid issuing from such a filter is usually quite turbid and contains much finely-divided solid matter as well as much colloidal matter. Even the relatively pure waters that are filtered for domestic use through beds of sand contain

considerable colloidal matter that soon forms a thick, slimy coating on the surface of these beds; and in the treatment of sedimented sewage by intermittent application to beds of broken stone or other similar material, all the surfaces of this material quickly becomes coated with colloidal slime, which often increases in thickness to such extent as to cause partial clogging. Similarly, when sewage is treated in a septic tank, the sides and bottom soon become coated with precipitates of colloids that appear at first in small globular masses, and subsequently agglutinate into a continuous sheet. It has been claimed by some investigators that the formation of these organic precipitates is accelerated by the process of putrefaction, and that the effluent from such a septic tank passes much more freely through filter paper; but this was not found to be the case at Manchester, as previously mentioned. In regard to the physical nature of a colloidal solution, various opinions have been expressed by different investigators. Some picture such a solution as consisting of extremely minute particles in suspension, thus making a heterogeneous system of insoluble matter in a solid phase with the solvent in liquid phase. Others consider that a colloidal substance becomes hydrated or swells in volume by the absorption of water, and eventually becomes entirely dissolved, also that this hydration is always accompanied by a development of heat, and that the water thus absorbed is held comparatively strongly in combination. Another set of investigators maintain that only a portion of the absorbed water is held strongly combined, the remainder being held loosely, while still others regard a jelly as having a cellular structure like a honey-comb, or else with the cells outlined by filaments instead of continuous thin partitions of solid or semi-solid matter. Lastly, it has been held that a colloidal solution consists of a mixture of two similar solutions, one containing little and the other much water, and having different viscosities, whereby a surface tension is developed between them upon which the formation of the emulsion depends.

4007 Colloidal solutions are known to be extremely sensitive to changes of temperature, and also to vary in character with

quiescence or agitation. The mechanical coagulation of such a solution seems to require the presence of a freely exposed surface of some kind whereby a change of surface tension is induced. By the addition of electrolytes, most colloids will be precipitated from their solutions in the same manner as finely divided suspended matter is precipitated. Such precipitation of colloids has been regarded as being due to the abstraction of water therefrom by salts or electrolytes; but in general the coagulating action of a salt will depend on its ionic or electrical relations to the substance. The stability of a colloid is considered to be the greater in proportion as its particles are smaller and as their electrical charges are greater. True colloids like albumen can be protected from precipitation by adding stable colloids to them.

Aside from the various colloidal substances, it is also known that a large proportion of the finely-divided solid matter suspended in sewage will settle only after the lapse of many hours during which the liquid is kept in a quiescent condition. Recent investigations of these slowly sedimentable particles which are usually found in the effluents from sewage tanks in sufficient quantity to cause strong turbidity, have proved that they consist of putrescible organic matter, and that they in conjunction with the colloidal matter, make up the greater part of the putrescibility of such effluents, as determined by the methylene blue test. Both of these kinds of matter cannot be removed by screens nor by sedimentation in open tanks during a period of one or two hours, and the quantity of such matters in suspension depends on the quality, condition and treatment of the sewage before arriving at the tanks. Dr. Arthur Lederer, chemist and bacteriologist of the Sewage Testing Station of Chicago, found in a number of his tests with relatively fresh sewage that after 4 hours' sedimentation the liquid still retained in suspension 4008 from 54 to 67 per cent. of the original amount of suspended matter, and that in his other tests it was always more than 30 per cent. Similar results were also obtained by Mr. C. B. Hoover, chemist of the Columbus Sewage Works, and still larger figures have been observed in the effluents from certain septic tanks in regular operation in warm weather. As all of the finely divided solid matter in suspension and many of the colloidal substances are visible to the eye, I am of the opinion that particles of suspended matter will be plainly visible in the effluent proposed to be discharged near Robbins Reef Light from the Passaic Valley Sewerage works. These suspended particles will be plainly visible in the waters of upper New York Bay after such discharge.

Q. Have you made an exhaustive study of the amount of suspended matter in the sewage of cities, that will deposit in settling tanks within periods of one hour and 1½ hours; and if so, state the percentage of such matter that will settle within these periods?

Mr. Riker: Same objection as to the last question.

The Commissioner: Note the objection of Counsel for the Defendants.

A. By reason of the septic character of the sewage, its long course of transit, the action of the pumps and the additional fermenta-

tion that must inevitably occur in the sedimentation tanks in warm weather, the solid matters which are carried in suspension in the liquid will be extensively comminuted. This reduction of size renders their sedimentation more difficult, and a much smaller quantity of such matter will be deposited in the tanks than if the sewage were fresh and flowed quietly by gravity into them. Mr. George A. Johnson has testified for the defendants in this suit that in his opinion about 35 per cent. of the total amount of suspended matter would be deposited in the proposed sedimentation tanks during a period of from 1 to 1½ hours, and he based this opinion on the results which he obtained with fresh sewage at Columbus, 4009 Ohio, in a tank with a period of detention therein of 1.3 hours. These results indicated a removal of 34 per cent. of

the suspended matter, as given on page 78 of Mr. Johnson's report published in 1905. This shows that 66 percent. of the suspended matter escaped with the tank effluent, and it is evident to every one who is familiar with sedimented sewage that most of these particles of matter will be plainly visible in the liquid. It should also be noted that the effect of sedimentation is by no means uniform. It varies greatly with the nature and size of the particles, as well as with the quietness and temperature of the liquid. At high temperatures sedimentation proceeds much more slowly than at lower temperatures in perfectly quiescent and clean water. When the sewage reaches a temperature of 60 degrees Fahrenheit or more, gases are evolved copiously by the fermentation of the organic matter in the sedimentation tank. The ascent of these gas bubbles through the liquid causes vertical currents which are opposed to the slowly descending particles and the bubbles themselves become attached thereto, thus making them rise and form a scum-like floating stratum which escapes with the effluent. In cold weather, fermentation is much less active, the evolution of gas is greatly reduced, and the liquid remains quiet, so that the effluent becomes much clearer. The difficulty in sedimentation is usually with the small particles of organic matter whose specific gravity is nearly the same as that of water, and the smaller their size the longer the time required for them to settle on the bottom of the tank. In warm weather three or four hours are found necessary to accomplish the same degree of sedimentation that is attained in one or two hours in cold weather. The stipulation for the discharge of said sewage that was made by the Secretary of War, provides for a period of sedimentation of not more than 1½ hours. In my opinion this period of time is inadequate in warm weather to secure the removal of even 30 per cent. of the suspended matter in the sewage that will enter the proposed settling tanks. The reasons for this opinion have already 4010 been given; and supplementing my previous answer, I believe that a countless number of particles of matter contained in the effluent from said tanks will be plainly visible in the water of the Bay near Robbins Reef Light.

Q. Have you made an exhaustive study of the amount of suspended matter in the sewage of cities, that will be arrested by or

caught on screens having apertures or openings $\frac{1}{2}$ inch in size; and if so, state whether such amount is as large as 10 or 15 per cent?

Mr. Riker: Same objection as to the last question.

The Commissioner: Same as before.

A. Mr. George A. Johnson testified for the defendants in this suit that a screen having clear apertures or openings $\frac{1}{2}$ inch in width would remove or arrest about 15 per cent. of the total suspended matter in the sewage of the Passaic Valley District. The data on which this testimony was based were not given, and I have examined many official reports of sewage treatment published in this country and abroad, in the hope of finding confirmatory results, but without success. In his experiments with the sewage of Columbus, Ohio, in 1904, Mr. Johnson caused the sewage to pass in succession through two diamond-mesh wire cloth screens, of which the first had clear openings of $\frac{1}{2}$ inch, and the second of $\frac{3}{8}$ th inch, as set forth in his Columbus Report, 1905, page 59, bottom. The wet matter thus caught on these two screens is stated on page 22 of said Report to have had a volume of 0.17 cubic yard, or 4.59 cubic feet, and to have weighed about 300 lbs., on the average, from every million gallons of sewage. An analysis of this wet matter is not given in said Report; but from analyses of similar matter taken from sewage screens elsewhere it is found that from 75 to 90 per cent. of the weight of the wet screenings is water, the remainder being dry solid matter. The crude sewage of Columbus contained about 200 parts of dry suspended matter per million by weight, the averages ranging from 196 to 242, as given on page 77 of said Report. Now, if the wet screenings at Columbus contained 4011 20 per cent. of dry solid matter by weight, then the

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said two screens removed on the average $\frac{\quad}{5} = 60$ lbs. of such matter per million gallons, or 8,350,000 pounds of sewage; hence

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the rate of removal was $\frac{\quad}{8.35} = 7.18$ parts per million by weight.

But the sewage contained from 196 to 242 parts of suspended matter per million by weight, and therefore the said two screens actually removed only from 2.9 to 3.7 per cent. of the total suspended matter in said sewage. This result is very different from the 15 per cent. removal claimed by Mr. Johnson for the $\frac{1}{2}$ inch screen proposed for the sewage of the Passaic Valley District. Another case is afforded by the experience gained in the treatment of the sewage of Reading, Pennsylvania, as set forth in the Official Report of Mr. E. B. Ulrich, City Engineer, for the year 1912. For the last 4 months of that year the sewage was screened exclusively through plates having round perforations $\frac{1}{2}$ inch in diameter, and the quantity of wet matter thus removed was on the average 2.925 cubic feet per million gallons of sewage. The weight of this wet matter is given at about 60 lbs. per cubic foot by Mr. E. S. Chase, chemist of the Reading sewage works, in a paper published in "Engineering News" of Au-

gust 22, 1912, pages 340 to 345, and its content of water at 79.6 per cent. With these data, the dry solid matter in the said volume of screenings is 35.8 pounds per million gallons or 8,350,000 pounds of sewage, or at the rate of 4.29 parts per million by weight. The total amount of suspended matter in the crude sewage is not given directly, but from the figures relating to sludge removed in the different stages of treatment, I have computed that it must have been about 150 parts of dry solids per million by weight on the average; hence the said screening with $\frac{1}{2}$ inch perforations removed only about 2.8 per cent. of the suspended matter. Numerous instances of similar nature might also be cited to show the strong improbability that a screen with $\frac{1}{2}$ inch openings is able to remove 15 per cent., or even 10 per cent. of the total suspended matter in ordinary municipal sewage; and hence I believe that Mr. Johnson has erred greatly in his aforesaid estimate of suspended matter that will be removed by the proposed $\frac{1}{2}$ inch screens from the sewage of the Passaic Valley District.

Q. Taking into full consideration the entire testimony you have heard given by the witnesses produced by the defendants at Newark, New Jersey, together with your own personal observations, experience and research, and the recorded experiences and experimental investigations of recognized scientific authorities on sewage and sewage disposal, what in your opinion will be the condition of the sewage effluent proposed to be discharged by the Passaic Valley Sewerage Commission near Robbins Reef Light, and in your opinion will it or will it not create a nuisance?

Mr. Riker: Same objection as to the last question.

The Commissioner: Same as before.

A. In my opinion the sewage effluent will have an offensive odor in warm weather; it will then be in a septic condition creating an odor nuisance. It will also be strongly turbid.

Mr. O'Sullivan: He is your witness, Mr. Riker.

Cross-examination by Mr. Riker:

Q. In the testimony which you have given what effluent have you assumed as the basis of your testimony?

A. An effluent coming from the proposed sedimentation tanks of the Passaic Valley Sewerage District, these tanks being located on the shore of Newark Bay in the southern part of the present City of Newark.

Q. You say the proposed work? Do you know what is actually proposed by the Passaic Valley Sewerage Commissioners?

A. I have seen plans that were prepared by the engineers of the Passaic Valley Sewerage Commission, and I believe that those plans represent the intentions of the Passaic Valley Sewerage Commission.

Q. Why do you believe that? On what do you found your belief?

A. My belief is founded on the title of the plans.

Q. When were they made, do you know?

A. I do not know definitely. The dates are, I believe, inscribed on those plans.

4013 Q. Can you say whether—

A. (Interposing.) I saw the plans in 1912 or 1911.

Q. Well, what was the date; when were they made, do you know?

A. I do not remember the dates written on these different plans.

Q. Were they within 5 years of the present time?

A. Yes, sir.

Q. You are sure of that?

A. Yes, sir. They were made subsequent to the date of the publication of the report of the Passaic Valley Sewerage Commission in 1908.

Q. How long subsequent?

A. I cannot tell that definitely from memory. The titles of the plans and maps will indicate that.

Q. Will those plans, as you say, you understand that they were proposed by the Passaic Valley Sewerage Commissioners, produce an effluent, the result of which will be as guaranteed in Complainants' Exhibit No. 135 when discharged into New York Bay?

A. I do not think they will; I do not think that the effluent will comply with the conditions there set forth.

Q. Well, do I understand you then, that you do not believe that the Passaic Valley Sewerage Commissioners propose to produce such an effluent that will result as stated in this stipulation entered into by them and the State of New Jersey with the Government of the United States of America?

A. No, I do not wish to state that the Passaic Valley Sewerage Commission has any intention of avoiding the stipulations, but I refer to the plans of that commission as I have seen them of recent date.

Q. But Mr. Kuichling, you said that the proposed works would result in a nuisance in New York Harbor. Now, if the effluent that is intended by the stipulation is the effluent that is proposed by the Commissioners, in your opinion will it or will it not be necessary to introduce other works into the disposal plant?

A. It will be necessary to introduce other methods of operation and possibly additional works.

Q. Why do you say then—do you mean to say then that
4014 the commissioners do not intend in producing the effluent which they have stipulated to produce, to introduce whatever works and processes are necessary?

A. No, sir, I do not say that. I merely say that in these stipulations certain structures are prescribed. I infer from the language of the stipulations that it was the belief at that time that those structures of the dimensions described would comply with the results called for. It is my opinion that they will not comply.

Q. And do you not also infer from the language of the stipulation that if these things that are specified do not produce the results that the commissioners will introduce others?

A. I see no evidence as yet that has been offered anywhere that

the Passaic Valley Sewerage Commission intends to provide additional plant or method of operation.

Q. That is hardly an answer to my question, Mr. Kuichling. I ask you now to look at the stipulation itself at the beginning of the second paragraph, and see whether you do not find indications that if the belief in the efficiency of the specified plant is mistaken, that the commissioners proposed to introduce other processes or works which will result in the effluent producing results as guaranteed in the stipulation?

A. I read in the second article of the stipulation that the results shall be secured either through compliance with the requirements of the immediately preceding paragraphs or through requisite, lawful additional arrangements. Now, there is an alternative. It is either one of two things.

Q. I ask you whether you do not get from the stipulation itself a sufficient intimation and assurance that if the specified plant and works and processes will not produce the effluent, that there will be others introduced which will produce the effluent?

A. I do not see it from the language there, because an alternative is proposed. It is either the prescribed plant or through requisite, lawful additional arrangements. Now, I may be, perhaps, a little doubtful about the meaning of this language. To me it is ambiguous. It presents an alternative, the choice between two things.

Q. You think the commissioners have the choice of doing 4015 one or the other?

A. Yes.

Q. And do you think, then, they have any choice about producing an effluent under this stipulation in accordance with the terms of the stipulation?

A. Well, if they comply with the requirements, the physical requirements, set forth, I do not see that the character of the effluent has much to do with the case.

Q. You do not see that they have guaranteed—you do not understand from this, then, that they have guaranteed results in New York Bay from the effluent, is that what you mean?

A. Yes, because they have the choice of two things. They can either comply with these prescriptions, set forth, or they can put in additional things. It leaves it perfectly optional.

Mr. Riker: I do not think I want to ask you any more questions, Mr. Kuichling. I think that will do for you.

Redirect examination by Mr. O'Sullivan:

Q. Mr. Kuichling, have you seen the detailed plans of the Passaic Valley Sewerage Commissioners prepared by Edlow Harrison and William G. Taylor, for December 1910, undertaking to comply with these stipulations, so far as producing an effluent that will give the results guaranteed?

A. I have seen a large number of such plans.

Q. Of the dates that I have stated?

A. Of the dates stated by you.

Q. Will the plans that you have seen for the sewage disposal system to be installed on Newark Meadows yield the effluent that is stipulated for or whose results are guaranteed in Complainants' Exhibit No. 135?

Mr. Riker: This question is objected to, because this witness has said that he does not understand that any such thing was guaranteed in the stipulation.

The Commissioner: Note the objection of Counsel for the Defendants.

The Witness: They will not.

Mr. O'Sullivan: That is all.

Adjourned to Tuesday morning, June 3rd, 1913 at 10:30 A. M.

4016 Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COMMISSIONERS, Defendants.

NEW YORK CITY, June 3rd, 1913—10.30 a. m.

Before James D. Maher, Esq., Commissioner.

Appearances:

William J. O'Sullivan, Esq., Special Counsel for the people of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

FREDERICK W. SCHWARTZ, a witness for the Complainants, called in rebuttal, being first duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Doctor?

A. Frederick W. Schwartz.

Q. Where do you reside?

A. Albany, New York.

Q. What is your profession?

A. Doctor in chemistry, Rensselaer Polytechnic Institute.

Q. Where did you pursue your technical studies, Doctor?

A. I received the degree of Bachelor of Science, from the Rensselaer Polytechnic Institute, and the degree of Doctor of Philosophy from the Columbia University, New York City.

4017 Q. Did you go out somewhat recently on New York Bay with Professors Phelps, and Mason for the purpose of taking samples of the Bay water and subjecting the same to analyses for dissolved oxygen?

A. I did.

Q. Upon what dates did you go?

A. April 21st, 22, 23, 24, 25, and 26th, 1913.

Q. What portions of these days did this work occupy?

A. It occupied from 9 o'clock in the morning until about 4 o'clock in the afternoon.

Q. At what points were the samples taken, and also the depths at which they were taken?

A. The samples were taken about half a mile northeast of Robbins Reef, and in mid-channel of the Kill Van Kull, opposite Sailors Snug Harbor, and the depths were 5 feet, 10 feet, and 20 feet below the surface.

Q. When were these samples that were taken as you have described subjected to analyses for dissolved oxygen?

A. The samples were analyzed upon the launch immediately after being taken; that is, after the samples was taken the analysis was started immediately, and the boat headed for the other sampling station, the time of analysis being about 30 minutes; that is the time necessary for the boat to make one trip between the two sampling stations.

Q. How many samples in all were taken during the days that you have stated?

Mr. Riker: I object to this testimony on the ground that it is not rebuttal, not directed to anything in the testimony of the defense. The testimony of the defense did not deal in any respect with the analyses of Harbor waters.

The Commissioner: Note the objection of Counsel for Defendants.

Mr. O'Sullivan: This line of inquiry is pressed by Complainants' Counsel for the reason that certain statements were made by

George A. Johnson, an expert called by the defendants,
4018 relative to the sewage to be discharged at the outfall at Robbins Reef, and as to the Condition of the waters going through the Kill van Kull, and this testimony will be connected later in direct refutation of the statements made by Mr. Johnson.

The Witness (answering): 224 samples.

Q. Will you describe the method used in making the analyses or the oxygen determinations that you have testified to?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

The Witness (answering): The method used was the Levy Method, the original Levy Method, which consists of a standard pipette having stop-cocks at each end, one end being a funnel top. The sample of water having been put into the pipette, the stop-cocks are closed. 2 cubic centimeters of sodium hydroxide are added in the funnel. The lower stop-cock is opened and the

upper stop-cock cautiously opened until the re-agent enters the pipette. After the re-agent has entered the pipette, both stop-cocks are closed, the funnel is thoroughly rinsed in distilled water, then 3 cubic centimeters of ferro sulphate solution are added to the funnel, and the stop-cocks are opened again for the other re-agent. Then after the re-agent has entered, both stop-cocks are closed, and the pipette is shaken. This produces ferrous hydroxide, which in the alkaline solution is oxidized by the oxygen of the water if it be present, to ferric hydroxide. After a lapse of 10 minutes or more, 2 cubic centimeters of concentrated sulphuric acid are added to the funnel, the upper stop-cock only is opened, and the strong acid allowed to run into the solution. This makes the solution acid, dissolves the hydroxides of iron and makes the solution clear. It is then run into a flask or casserole and titrated with standard potassium permanganate solution. After this has been done, a blank is run using the same quantity of water, but changing the order of the addition of the chemicals. In this case the acid is added first, then the sodium hydroxide and then the ferrous sulphate solution. The titration is made as before with standard potassium permanganate. From the amounts of potassium permanganate used for the sample and for this blank we deduct from the blank the amount used by the sample and subtract for the volume of the re-agents added, multiplied by the volume in cubic centimeters of oxygen of the permanganate, and calculate the results to cubic centimeters of oxygen per litre.

Q. Have you fully described the method known as the original Levy Method, now, Doctor Schwartz?

A. This is the original Levy Method.

Q. Is it a recognized method of analysis for oxygen determinations?

A. It is.

Q. Why did you choose that particular method?

A. It is the method used by the Metropolitan Sewerage Commission of New York City.

Q. What other observations were made at the time of taking these samples?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. A record of the temperature of the water and of the condition of the tide was also made and recorded.

Q. Did you keep full notes of what samples were taken, the time of day at which they were taken, and the analytical results secured?

A. I did.

Q. Have you got your laboratory note books with you?

A. Yes, sir.

Q. Will you give me the number of samples that was taken at the two different points that you have stated that you took samples from on each of these days in April?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. On April 21 at Robbins Reef there were 13 samples taken, at Kill van Kull, there were 7 samples taken. On April 22nd at Robbins Reef there were 19 samples taken, and at Kill van Kull 20 samples. On April 23rd, there were 24 samples taken, 4020 and at the Kill van Kull 20 samples. On April 24th, at Robbins Reef, 20 samples, and Kill van Kull 16 samples. On April 25th, at Robbins Reef 28 samples, and at Kill van Kull 24 samples. On April 26th, at Robbins Reef, 18 samples, and 15 samples at the Kill van Kull.

Q. Have you made an average of your detailed results showing the amounts of dissolved oxygen present in the water at the two sampling stations, and if so, will you state what they were, Doctor?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. In cubic centimeters of oxygen per liter.

	Robbins Reef.			Kill van Kull.		
	Average of	Elkh.	Flood.	Average.	Elkh.	Flood.
17 samples.....	5.97	6.30	6.08	6.05	6.35	6.12
19 ".....	5.94	5.96	5.96	5.94	6.00	5.96
20 ".....	6.01	5.73	5.67	6.02	6.23	6.00

Q. Doctor Schwartz, did you secure other samples of water for other purposes, and if so state for what purposes, and to whom you delivered them?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I took samples of water for the Bacteriological examination and those were taken for four days, three of those days the samples were delivered to Professor Phelps, the fourth day they were delivered to Mr. Bonney.

Q. In what shape or condition were they when you delivered them; how did you prepare them for delivery?

A. The bottles were sterilized; when I received them the samples were placed in the bottles. The bottles were placed in a copper box which had a bottom or container for ice. This whole box was then placed in a fibre case, and it was in that form the samples were delivered.

Q. By whom?

A. I delivered them in that condition to Professor Phelps on the three days, and on the fourth day to Mr. Bonney.

4021 Mr. O'Sullivan: He is your witness.

Mr. Riker: No questions.

ALSON BONNEY, a witness in behalf of the Complainants, called in rebuttal, being first duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your name, Mr. Bonney?

A. Alson Bonney.

Q. Are you connected with any laboratory in the City?

A. Yes sir.

Q. Whose laboratory?

A. Doctor North's laboratory.

Q. In April did you receive any samples of water for bacteriological examination from anyone?

A. I did.

Q. From whom?

A. On three days from Professor Phelps, and on one day from Doctor Schwartz.

Q. How did you receive these samples and what condition were they in when you received them?

A. The samples were received in 2 ounce bottles, and the bottle were in an ice pack.

Q. What did you do on receiving the package with the bottles as you have described?

Mr. Riker: The question is objected to on the ground that it is not rebuttal of any testimony offered by the defence.

The Commissioner: Note the objection of counsel for the defendants.

A. These were immediately taken to Doctor North's laboratory.

Q. Describe what you did now, Mr. Bonney, with them?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The samples were now analyzed for B. coli and bacteria contained according to the method set forth by the standard method of the American Public Health Association.

Q. Will you describe in detail how you made these determinations, Mr. Bonney?

4022 Mr. Riker: Same objection.

The Commissioner: Note the objection.

Mr. O'Sullivan: Describe what you did, how you did it. Give whatever specific tests you applied in making your bacteria examinations.

The Witness: In analysing for the bacteria contents we used 2 Petrie dishes, one for 37 degrees temperature, and one for 20 degree temperature. In both these plats were placed 1 Cc. of water, and to this was added agar agar media. These plates were then placed in an incubator at the prescribed temperature, and allowed to stand for the required number of days for the B. coli determination we used 10 bile tubes to each sample. Into these tubes were inoculated

1 cc. of water, and these tubes allowed to stand in the incubator at the proper temperature for the number of days.

Q. After starting the operations that you have just described, who completed those?

A. Doctor North observed and recorded the results of the analyses.

Mr. O'Sullivan: He is your witness.

Cross-examination by Mr. Riker:

Q. Do you know where the samples came from?

A. Yes, the samples came from the Harbor of New York City.

Q. How do you know?

A. Why, I was on the boat when the last set of samples were taken, and Professor Phelps told me the other sets were taken from there.

Q. Your belief rests then, in part upon Professor Phelps' word to you?

A. On the first three days, yes sir.

Q. Well, don't you think that is a basis for stating that you know where this came from.

A. On the last day I know where they came from.

Q. As to the other days, do you know?

A. Only what Professor Phelps told me.

Mr. Riker: That is all Mr. Bonney.

4023 CHARLES E. NORTH, a witness in behalf of the Complainants, called in rebuttal being first duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Doctor?

A. Charles E. North.

Q. And what is your profession?

A. Consulting sanitarian.

Q. Where did you pursue your technical studies, Doctor; state what degrees you took?

A. I got the degree of A. B. at Wesleyan University, Middletown, Connecticut, specializing in chemistry and biology; M. D. at Columbia University, New York.

Q. Have you specialized in your profession now?

A. Yes, sir.

Q. What specialty?

A. Consulting sanitary work connected with, particularly, water supplies and milk supplies.

Q. Did you hear the last witness, Mr. Bonney, testify?

A. Yes sir, I did.

Q. Is he connected with your laboratories?

A. He is one of the assistants in my laboratories.

Q. Did you hear him describe what he did with certain samples which he received from Professor Phelps?

A. Yes sir, I did.

Q. And certain samples which he testified he received from Doctor Schwartz?

A. Yes sir.

Q. What did you do in connection with those samples?

Mr. Riker: The question is objected to on the ground that it is not rebuttal of any testimony offered on behalf of the defence.

The Commissioner: Note the objection of Counsel for the defendants.

A. I instructed Mr. Bonney how to analyze these samples, how to start the analysis and then I personally inspected all of the samples which he had placed under cultivation, and at the end of the required period of time I noted the results and recorded the same, and sent a report to Professor Phelps.

Q. What special tests did you apply in your bacteriological determinations, Doctor North?

4024 Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I used the tests prescribed by the standard methods for the bacteriological analysis of water, and of sewage by the American Public Health Association. These tests are three in character, the first relating to the number of bacteria present by the plate method at 2 degrees of temperature, namely, the blood heat of 37 degrees centigrade and the room temperature of 20 degrees centigrade; and the second test which has as its object the determination of the relative number of acid-forming organisms and other species of bacteria by the use of Lactose litmus agar plates. The third test is called the fermentation test for *B. coli* by the use of lactose bile. This has as its object the determination of the number of *B. coli* present in one c. c. or fractions thereof.

Q. What was the result of your bacteriological analyses of the samples of water?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I have tabulated the results in the form of a report showing the number of samples taken and the number of bacteria present in each sample by the plate method, and also the number of acid-forming organisms if the lactose litmus agar, and the number of fermentation tubes in which gas was formed. These all appear in detail on this report.

4025 "Results of Bacteriological Examination of Samples of Water Taken from New York Harbor on Dates Given Below.

Date.	Lab. No.	Description.	Bact. per c. c., 24 hrs., 37°.	Lact. Lit. agar, 24 hrs., 37°.		Bact. p'r c. c., 48 hrs., 20°.	Fermenta- tion tubes, 1 c. c. ea.	
				Red.	Others.		Pos.	Neg.
4/22.	7091.	Mkd. No. 2	90	15	75	600	10	0
	7092.	" " 4	140	20	30	640	10	0
	7093.	" " 9	450	90	300	3,200	1	9
	7094.	" " 15	160	40	30	400	10	0
	7095.	" " 20	1,200	100	600	1,600	10	0
	7096.	" " 25	280	50	30	320	10	0
4/23.	7114.	" " 30	800	40	480	3,200	10	0
	7115.	" " 35	400	20	560	800	10	0
	7116.	" " 41	640	140	560	3,600	10	0
	7117.	" " 45	640	5	1,120	3,200	10	0
	7118.	" " 50	2,000	400	800	8,000	10	0
	7119.	" " 55	800	45	400	800	10	0
	7120.	" " 60	2,400	400	1,200	1,200	10	0
	7121.	" " 65	1,600	0	1,000	1,280	10	0
	7122.	" " 70	1,240	0	240	3,600	8	2
	7123.	" " 75	640	20	560	1,280	10	0
							1/10 c. c.	
							10	0
4/24.	7132.	" " 80	80	30	60	300	10	0
	7133.	" " 85	50	0	20	100	2	8
	7134.	" " 90	50	30	40	300	6	4
	7135.	" " 95	200	0	100	500	10	0
	7136.	" " 100	80	60	40	500	6	4
	7137.	" " 105	750	170	200	2,400	10	0
	7138.	" " 110	300	40	60	800	4	6
	7139.	" " 115	600	120	200	3,200	10	0
	7140.	" " 120	300	20	40	500	10	0

Date.	Lab. No.	Description.	Bact. per c. c., 24 hrs., 37°.	Lact. Lit. agar, 24 hrs., 37°.		Bact. p'r c. c., 48 hrs., 20°.	Fermenta- tion tubes, 1 c. c. ea.	
				Red.	Others.		Pos.	Neg.
4/24.	7141.	Mkd. No. 125	2,000	400	400	5,000	8	2
	7142.	" " 130	400	130	250	1,600	8	2
4/25.	7150.	" " 135	150	50	50	500	8	2
	7151.	" " 140	100	50	70	600	8	2
	7152.	" " 145	100	50	50	1,100	4	6
	7153.	" " 150	300	40	200	2,500	6	4
	7154.	" " 155	400	50	100	950	6	4
	7155.	" " 160	1,600	40	80	4,000	6	4
	7156.	" " 165	250	150	100	1,200	8	2
	7157.	" " 170	4,000	800	600	3,000	8	2
	7158.	" " 175	150	0	50	670	4	6

Mr. O'Sullivan: He is your witness, Mr. Riker.

Mr. Riker: No questions.

EARLE B. PHELPS, a witness in behalf of the Complainants, recalled in rebuttal, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. You have testified previously in this suit, Professor Phelps, have you not?

A. Yes sir.

4027 Q. Now, has your attention been directed to the testimony of Mr. George A. Johnson at pages 3960 and 3962 relating to the collection and examination of specimens of sewage from the outlets of thirteen sewers discharging into the Passaic River at various specified points between Paterson and Newark?

A. Yes sir, it has.

Q. Does the mode of collecting and the deductions made by Mr. George A. Johnson conform with your experience under like conditions, and if not, state fully why not?

A. They do not. In his description of the method of collecting the samples as found on page 4060 of the typewritten record Mr. Johnson states "In some cases it was not feasible to enter the sewer and in those cases a large bucket of the sewage was drawn up from the sewer and the sample bottle filled from it as above described." In the course of an investigation of the sewage of the City of Boston, which extended over about eight years, I had occasion to make a careful study of the best method of collecting samples of sewage for the dissolved oxygen test. Water in its pure state or mixed with other ingredients such as we find in sewage has a great tendency to dissolve oxygen from the atmosphere. Under any given state of conditions there is a maximum amount of oxygen which can be thus dissolved and water which holds that amount in solution is said to be saturated. A saturated water, therefore, can dissolve no more oxygen. Normal or unpolluted waters which are unpolluted naturally contain a full quota of oxygen or practically so. It has been found necessary in collecting samples for analysis to absolutely preclude any contact of the water to be examined with the air. As the percentage of saturation is diminished by contained impurities, the water seizes oxygen from the air with greater and greater rapidity. In the case of sewage where the oxygen content is always low and is sometimes actually zero, the rapidity with which oxygen is dissolved by the water upon exposure to the air is very great and the precautions necessary to prevent such solution must be extremely rigid. The method of collecting a bucket of sewage from the
4028 sewer and later taking this off into bottles is faulty in the extreme and results obtained by any such method will necessarily be unreliable. Moreover, they will always be higher than the true value.

Q. Higher in what?

A. In dissolved oxygen.

Q. What does the presence or the absence of dissolved oxygen in sewage depend upon?

Mr. Riker: I object to that as not rebuttal of any testimony offered on behalf of the defence.

The Commissioner: Note the objection of Counsel for the defendants.

A. The presence or absence of dissolved oxygen in sewage depends entirely upon the condition of the sewage as regards its age and its temperature. All sewages, if examined at a sufficiently early stage, show the normal dissolved oxygen of the water supply which makes up their principal volume. The mere presence of dissolved oxygen in sewage is in no sense a measure of the character of that sewage, nor can one determine by such analytical data the effect of the discharge of such a sewage into a stream. The statement that the discharge of sewage containing from 50 to 75 per cent of saturation of oxygen into a river which may contain less dissolved oxygen at that time exerts a refreshing action upon the river is misleading. Consideration of the dissolved oxygen in sewage is strictly equivalent to the consideration of the assets in a bank statement. A complete interpretation of conditions requires also a consideration of the liability side of the balance sheet. The opposing side in the sewage analysis is the amount of oxidizable material present. A correct impression of the character of the liquid can only be obtained by a comparison of these two values, namely, the dissolved oxygen or oxygen resources on the one hand, and the oxidizable organic matter or oxygen requirements on the other. This position is obvious if we consider the comparative oxygen balance of a fresh sewage and of the New York Harbor water, assuming both to contain 4029 70 per cent of saturation of dissolved oxygen. In the case of a harbor water the oxidizing reactions that have taken place have produced a condition of essential equilibrium. A sample of this water if stored in a tightly stoppered bottle for twenty-four hours will lose little if any of its dissolved oxygen during that time; whereas a sample of the sewage containing at the start the same actual amount of dissolved oxygen, similarly stored, will lose all of that oxygen within an hour or so.

It is this balance or deficit of dissolved oxygen obtained by comparing the available oxygen with the oxygen requirements of the liquid that determines its actual character and its influence upon any stream into which it may be discharged. It is entirely improper to use the dissolved oxygen figure alone as a criterion or measure of condition.

When sewage is diluted in a large volume of water containing a reserve of dissolved oxygen, bio-chemical reactions are set up which result in the withdrawal of oxygen from the water and equivalent oxidation of the organic matter in the sewage. This process continues until it comes into virtual equilibrium, at which point the stream is able to obtain by re-aeration from the atmosphere as much oxygen as is required for the continuance of the oxidizing reaction. Complete equilibrium is only obtained when the reaction itself has

been fully carried out. Studies which I carried out some years ago on the capacity of New York Harbor to receive and digest sewage indicated that the average sewage which is now being discharged into New York Harbor requires — the summer time approximately 2,000 pounds of oxygen for each million gallons of sewage before a condition of virtual equilibrium would be reached. Converted into our ordinary analytical units this is equivalent to approximately 240 parts per million of dissolved oxygen or 2.700 per cent of saturation. This means that if — given a volume of sewage were 100 per cent saturated with oxygen it would still show 4030 a- oxygen deficit equivalent to twenty-six times its total available oxygen. Expressed in another way, such a sewage if diluted in twenty-six equivalent volumes of pure water also saturated with oxygen would entirely exhaust not only its own oxygen supply but the entire supply of these additional twenty-six volumes of water. The implication, therefore, conveyed in the statement made by Mr. Johnson that sewage because it had 50 or 75 per cent of dissolved oxygen would exert a refreshing reaction upon a stream containing a less per cent of dissolved oxygen is erroneous and misleading. Fifty per cent of dissolved oxygen in an average city sewage represents approximately a 54th part of the amount of dissolved oxygen required by such a sewage before it would reach equilibrium, so that this 50 per cent of saturation, instead of representing an asset, represents a very serious deficit. It is quite immaterial from the point of view of river pollution how much oxygen the sewage may happen to contain at the time of examination. As I have previously stated if it could be examined at a sufficiently early stage, sewage would contain nearly 100 per cent of saturation. This is because of the fact that the sewage as it enters the sewer is made up in the greater part of its bulk by fresh water from the city mains, which is normally saturated with dissolved oxygen. If the sample be examined before the biological reactions, which begin at once, have progressed materially, one can obtain nearly 100 per cent of saturation in any city sewage. All sewages are similar in this respect and they are similar in the further respect that within a comparatively few hours, the time depending upon the temperature and rapidity of the biological reactions taking place this dissolved oxygen will have become exhausted and there will still be an oxygen requirement left in the sewage, which is so much greater than the amount of oxygen originally present that that latter amount becomes a non-essential detail.

Q. Have you recently made an investigation of the actual present condition of the waters near Robbins Reef Light and the Kill van Kull?

A. I have.

4031 Q. Were you present when Doctor Schwartz testified just now?

A. I was.

Q. Were you present when Mr. Bonnev testified?

A. I was.

Q. Did you hear both witness' testimony?

A. I did.

Q. Where did you receive the samples of water that you gave to Mr. Bonney?

A. Those samples that have been testified about were collected by Doctor Schwartz in my presence, and under my oversight and under Professor Mason's oversight, who was present also, on board the launch upon which we made the trips down the Harbor on the days mentioned, April 21, 22 and 23. Two sampling stations were established on those days: One at a point one-half mile northeast of Robbins Reef light, on the edge of the channel, the other in mid-channel in the Kill van Kull, at a point directly opposite the Sailors Snug Harbor. At each of those stations, samples for the determination of the dissolved oxygen were taken, and also samples for bacteriological examinations. The latter samples were all taken at a depth of 10 feet below the surface.

Q. Were you present, and did you hear the testimony given by Doctor North as to the results of his bacterial investigations on these samples?

A. I did.

Q. Now, in what did your investigations consist, Professor Phelps?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. My investigations consisted more particularly in the chemical work to which I have referred. In conjunction with Professor Mason I laid out a program for that work and also in conjunction with him and with Doctor Schwartz started that work off, and for three days was with the boat seeing all the operations, and assisting in some of them. My further investigations included a compilation of the results and the detailed study of them in their interpretation. The work was undertaken for the purpose, among other things, of determining the oxygen balance of the waters in the neighborhood of Robbins Reef Light House, and near the point of discharge of the Passaic Valley sewer, for the purpose of comparison with similar waters from the Kill van Kull. Any part
4032 of the sewage from the territory to be served by the proposed Passaic Valley sewer which now enters New York Harbor does so through Kill van Kull. This amount of polluting material has before reaching the waters of New York Harbor been subjected to certain processes of natural purification in the Passaic River and in Newark Bay and it was thought desirable to determine the condition of the oxygen balance as this polluting material reached New York Harbor through Kill van Kull.

For this purpose, in addition to the regular determinations of the dissolved oxygen in the water at various stages of the time, samples were taken simultaneously for storage in tightly sealed bottles. At the expiration of twenty four hours, the samples having been maintained in the meantime at a temperature of approximately 20 degrees centigrade, a second determination of dissolved oxygen was made upon these stored samples. Actual agreement between the first and second values thus obtained would indicate a condition

of complete equilibrium and would show that the polluting material reaching New York Harbor through the Kill van Kull had been so completely oxidized that it would throw no additional burden upon the waters of New York Harbor. Any loss of dissolved oxygen in the process of storing would indicate a departure from this ideal condition and would show the magnitude of the load, placed, upon the waters of New York Harbor by the polluting material reaching it in this way. The results actually show a condition of virtual equilibrium, that is to say, there is a slight loss in dissolved oxygen observed during the period of storage but the actual amount of this loss is insignificant and it can be safely asserted that no serious additional burden is being placed upon the purifying capacity of New York Harbor waters by the pollution which reaches the Harbor through the Kill Van Kull.

Comparison of these results also with similar results from the vicinity of Robbins Reef shows that the waters reaching the Harbor from the Kill Van Kull are slightly superior in character to the waters of New York Harbor, and that, therefore, under present conditions, the pollution from the region of the Passaic

Valley that now reaches New York Harbor is relatively equal to, and certainly is no greater than, the pollution of New York Harbor from other sources, when these two separate sources of pollution are considered with reference to their respective dilutions and the volumes of oxygen bearing water with which they are respectively mixed. Expressed in another way, the oxygen balance relation between the present New Jersey pollution and the total tidal waters of Newark Bay and other waters by which that pollution is diluted is not dissimilar to the corresponding oxygen balance between the pollution from all other sources, and the diluting tidal waters with which the latter are mixed. It is this oxygen balance relation which must be kept in mind as the proper basis for comparing various classes of polluted water. The sewage of the Passaic Valley district is now by natural means brought into a state of virtual equilibrium before it reaches New York Harbor. This equilibrium is approximately of the same degree of completeness as exists in the remaining waters of New York Harbor and whatever may be said on the side of the necessity for further improvements of conditions in New York Harbor it can at least be said that the present distribution of the oxygen reserve of all the Harbor and tributary waters taken together among the various communities polluting these waters is at least an equitable one.

The proposed discharge of a large volume of sewage at the Robbins Reef outlet would alter seriously the present conditions. There would first of all, be a slightly beneficial effect upon the waters of Newark Bay and the Kill Van Kull, and there would next be a distinctly detrimental effect upon the waters of upper Harbor. It will be necessary for me to consider these two resulting effects in order to determine whether the benefit on the one side is sufficient to balance the detriment on the other. I have stated that the gradual is at a maximum. Under this condition on the body of water in which it is diluted, reducing thereby the dissolved oxygen of that

water. The greater such reduction the more rapid the
4034 absorption of additional oxygen from the atmosphere until a
condition of equilibrium is reached at which the absorption
is at a maximum. Under this condition on the body of water in
question may be said to be doing its maximum purifying work.
Newark Bay is in such a condition of equilibrium, and the result
of the examinations which we have made shows that the aeration
and other factors in the Bay have brought about practically com-
plete equilibrium, the complete oxidation of the polluting matter.
Moreover, Newark Bay has not suffered seriously, but has been able
to maintain its own condition by re-absorption of oxygen from the
atmosphere. By removing pollution from Newark Bay these waters
will have less work to do, will absorb less oxygen from the atmo-
sphere and will reach New York Bay in so far as they travel in that
direction in a condition somewhat better than their present con-
dition. This slight improvement, however, will add little or nothing
to the purifying capacity of New York Harbor itself. The ebb
waters through the Kill Van Kull flow to a rather large extent
directly out through the Narrows, so that they exert a minor influ-
ence upon the character of the New York Harbor waters. In the
second place, the total volumes that are affected by the flow through
the Kill Van Kull are small compared with the total volume of New
York Harbor. The net effect, therefore, of removing all sewage
pollution from Newark Bay would in consideration of all these
various factors be extremely small. The Passaic Valley district is
not to-day an important factor in the pollution of New York Harbor
waters. On the other hand, the additional of a large volume of
sewage to the upper New York Bay would throw a heavy burden
upon the purifying power of those waters. All the oxidizing work
which Newark Bay is now doing will have to be done in New York
Bay. The discharge of 350 millions gallons of sewage at Robbins
Reef would throw such a burden upon the waters of New York Bay
that the dissolved oxygen would be lowered to at least 40 per cent of
saturation by the most conservative calculation. This calculation is
based upon the average oxygen requirement of city sewage
4035 and upon the power of reaeration existing in New York Har-
bor determined by methods that are all in evidence in my
direct examination. The continued discharge of this volume of
sewage under all tidal conditions would result in carrying pollution
to the uppermost limits of New York City and computations of the
effect of such discharge upon the waters of the Hudson River at
Spuyten Duyvil show that during the summer season the dissolved
oxygen at that point would be reduced on the average of 25 per cent
of saturation. For comparison of this figure, I wish to state also
that some determinations of the dissolved oxygen of the Passaic
River at Newark, made in January, 1911, by me, showed that the
waters of the Passaic River at Newark contained at that time 38
per cent of saturation of dissolved oxygen. This figure is in evidence
in Complainant's exhibit No. 136, page 17. The deep waters of New
York Upper Bay and the Hudson provides a great dilution factor
but are less efficient in aeration than the waters of Newark Bay.

Therefore, work which Newark Bay with its broad shallow reaches would be relieved by this change without any material advantage so that Bay would be placed directly upon the New York Bay waters which are much less favorably situated for purification work.

Q. Professor Phelps was your attention particularly directed to the testimony of Mr. George A. Johnson at pages 4121 and 4122 relating to the larger suspended particles, and as to their being according to Mr. Johnson's testimony more putrescible than the smaller suspended particles?

A. Yes sir, I have read that testimony carefully.

Q. Will you state what is the relative stability of large and small particles of colloidal and dissolved material in suspension?

A. In any discussion of sewage purification methods the use of such a term as "percent of removal of suspended solids" is apt to be misleading unless one has in mind very clearly the purposes for which that sewage purification is undertaken. If the object of the purification is to remove suspended material because such material might otherwise deposit upon the banks and bed of a slow moving stream and thereby give rise to a nuisance or obstruction due directly to the fact that material was deposited, then the amount of material removed is a direct measure of the efficiency of the process.

If, on the other hand, the nuisance to be abated is of a biochemical sort and is manifested by a loss of dissolved oxygen in the stream due to the putrefaction of organic matter, then the expression quoted "percent removal of suspended matter" is no true index of the efficiency of the process and must be carefully interpreted in the light of other knowledge before it become useful information.

In the particular case at hand, we are not concerned primarily with a possible deposit of material for it can be shown that this can never be so serious as to interfere with navigation; but we are concerned with the capacity of New York Harbor to receive and assimilate pollution without suffering an undue loss of dissolved oxygen. Therefore, any statement of the removal of suspended solids may be misleading with the further statement of the effect of such removal upon the actual putrescibility or oxygen requirements of the sewage.

To understand this matter properly one must first consider the time factor in its relation to the oxidation of organic matter. We may for purposes of illustration imagine two samples of polluted water each having the same total oxygen requirement, so that each would ultimately exert the same effect upon the body of diluting water into which they might be discharged; but owing to the varying physical conditions of the organic matter in these two samples, it is quite possible and is frequently observed that in a given period of time, say six hours, the oxidizing reaction might proceed to 50 per cent of completion in the one case and to only 25 per cent of completion in the other. If during that six hours a further dilution occurs or if the water be exposed in comparatively shallow depths, or agitated so that considerable reaeration is possible, then it is obvious that the material which is oxidized slowly would produce a much

4037 less serious result in the stream than the material which is oxidized rapidly even though the total amount of oxygen requirement in the two cases be the same.

We have observed in the case of sewage now entering New York Harbor that the mere difference between summer and winter conditions in the sewer itself result in a ten fold increase in the rapidity of oxidation of the organic matter, even though the total oxygen requirements of the sewage are not materially altered. One of the principal reasons for this variability has been found to be the physical condition of the organic matter. This point has been investigated in much greater detail by Doctor Lederer of the Engineering Staff of the Chicago Sanitary District at the Experiment Station at Chicago. In a paper presented before the American Public Health Association Lederer showed as the results of his investigations that the rate of oxidation of suspended matter increases with increased fineness of material and that the same rule holds also with the still finer particles which may be termed colloidal material and material in true solution. He showed by conclusive experiments that a removal of 60 per cent of a suspended matter resulted in a removal of only 30 per cent of the putrescibility due to suspended matter. This variation is doubtless emphasized also by the fact that the grosser suspended material is composed in large measure of organic material which is actually less putrescible, such as street washings, paper, etc.

Our investigations made upon the Boston sewage enabled us to extend this principle in both directions. I have already shown that the greater percentage of soluble material, which results from the putrefaction within the sewer in warm weather brings about a very great rise in the rate of oxidation so that in summer the total effect is at times increased ten fold over winter conditions. At the other extreme the principal has been illustrated by studies of the relative stability of material removed by fine screening, such screening material being composed largely of paper, rags, matches, cork and 4038 other coarse matter was shown to have such a low rate of oxidizability that it was practically negligible. Although the removal of suspended organic matter by fine screening amounts to a relative high percentage of the total organic matter present and although fine screening is exceedingly desirable for other reasons, it can — be stated that such screening does not materially improve the character of the sewage as regards its rate of oxidation, and the resulting effect upon the stream into which it is discharged. The operation of screening and sedimentation applied to a sewage having the average age which the sewage of the proposed Passaic sewer will have upon reaching the purification works will in my opinion bring about two changes in the character of the sewage, these changes being of an opposite nature. There will be in the first place a removal of the gross material by screening and of a definite proportion of the heavier suspended solids by sedimentation. This will tend to reduce the total oxidizability of the sewage in question to an extent which will be much less than that indicated by the relative removal of organic impurities. The time required for the sedimentation will

also provide for further decomposition in the sewage which will have the same effect in ageing the sewage as would be had by increasing the temperature. That is, this additional storage will make the sewage more readily oxidizable and this increase in the rate of oxidation will in my opinion more than offset any advantage obtained by the removal of suspended matter. In addition to the general observations which I have made upon various sewages along this line, the view I have expressed here has been directly confirmed by experiments made by me at Providence during the year 1911. In that case the rate of oxidation of the sewage was found in the summer time to be increased as much as 50 per cent by storage in sedimentation tanks for a period of three hours. This net increase took place despite the fact that a considerable sedimentation was occurring simultaneously. From the point of view, therefore, of net oxygen requirements of the sewage as it is discharged at Robbins Reef within a period of six or twelve hours after discharge, it is my opinion that the proposed treatment will be of no benefit whatever and will be very likely a distinct disadvantage.

Q. Professor Phelps, will septic sewage or fresh sewage consume oxygen in larger or smaller amounts or with greater rapidity?

A. Septic will consume oxygen with much greater rapidity than fresh sewage.

Q. Sewage highly comminuted, macerated, travelling a long distance, and discharging in a septic condition—do you know of any conditions under which that could possibly benefit the body of diluent water in to which it will be discharged?

A. I do not, no sir.

Q. What gases are evolved from septic sewage.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The most conspicuous gas is hydrogen sulphide, which is an exceedingly offensive compound. It is the compound which characterizes a spoiled egg. Among others there are some organic sulphur compounds which are even more offensive than hydrogen sulphide—the so-called mercaptan. There are also amines, compounds which characterize decomposing fish, nitrogenous matters, which are very offensive in their odor. There are phenol, indol and skator—all characteristic of decomposing fecal matter, and others that are less offensive, such as carbon dioxide, and methane, gases of that character.

Q. Is there any relation between the volume of these gases evolved, and the degree of septicity in the sewage?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The total amount of gas evolved depends upon the degree of the septicity of the sewage. The rate of evolution would depend upon the temperature.

Q. Would you expect considerable malodorous conditions evolved from the septic sewage discharged in warm weather at a point such as Robbins Reef Light, and expect those malodorous conditions to reach Manhattan Island?

A. Judging by all previous experience, I certainly would.

Mr. O'Sullivan: He is your witness, Mr. Riker.

Cross-examination by Mr. Riker:

Q. What part did you have in the preparation of the stipulation between the United States and the State of New Jersey?

A. None whatever.

Q. Never submitted to you before it was executed?

A. No. I did discuss the matter with Colonel Black, the first time I ever met him.

Q. You were associated with Colonel Black in certain investigations?

A. After that, a year later.

Q. Do you recognize Colonel Black as anything of an authority in these matters?

A. I certainly do.

Q. Why do you speak of the discharge of the sewer as 350 million gallons a day?

A. Why, I think 360 millions gallons is the figure that is in evidence as the maximum amount.

Q. Why do you use the maximum?

A. In any engineering forecast of what is going to happen we look as far ahead as the works contemplate.

Q. How long ahead do you understand that is?

A. I am not certain.

Q. Don't you know?

A. If I did, I have forgotten.

Q. Don't you know it is twenty years?

A. I should not wonder.

Q. You are testifying in a suit, you understand that, do you not?

A. Yes.

Q. Which is directed at the correction of a nuisance immediately in New York Harbor, do you understand that?

A. I did not understand that we had to confine ourselves to an immediate nuisance; the sewer is to be built with a certain capacity and its capacity for discharge is 360 million gallons.

Q. And that means that it will immediately discharge 360 million gallons?

A. For all I know to the contrary it may.

Q. Do you know what the population to be served is?

A. Yes.

4041 Q. Don't you know that that population will not discharge 360 millions at the present time?

A. No.

Q. How much sewage do you estimate?

A. I know that the use of mill waste in Paterson alone amounts to 200 gallons per capita per day, and water used in washing silks, which is very foul, and make a very large item.

Q. Well, do you know how much it is estimated per capita?

A. That particular item I happen to remember about, 200 gallons per day per capita.

Q. And that happens to be the largest item there was?

A. Yes.

Q. And you are taking a maximum there to testify on, aren't you?

A. That is a possibility which may happen.

Q. Is that your method of testifying as an expert, to take the greatest possible maximum?

A. Always take the greatest possible harm that can be done by a contemplated engineering device, yes.

Q. And you are in the employ of the Metropolitan Sewerage Commissioners?

A. No.

Q. You are being paid for your testimony I suppose?

A. Yes.

Q. A regular per diem, I hope?

A. I think so.

Q. At what point is the stability which you have testified about to be reached at Kill Van Kull, at the point where you took samples, between the Oxygen and the sewage; at what point is that stability reached in the discharge of the flow of the sewage from the Passaic Valley?

A. I can only give you an opinion on that; I cannot give you any facts based on determinations.

Q. Haven't you tried to determine that?

A. No.

Q. Isn't that an important factor in the matter?

A. Not at all.

Q. You do not consider it so?

A. I am only interested in the condition of the water as it reaches New York Harbor.

Q. You were interested in determining something of value for the side you are employed on?

A. Determining the facts, yes, sir.

Q. So far as they seemed to bear on the side you are employed to testify on?

A. I don't know that I have eliminated any facts that seem
4042 not to bear upon it.

Q. You were in search of facts which would tend to establish the side on which you were employed, were you not?

A. No, sir; I was in search of facts.

Q. Why didn't you attempt to discover when the point of stability is reached?

A. Because that had no possible bearing on the question.

Q. You don't think it has; that is your opinion?

A. If I had a contrary opinion, I would have sought it out.

Q. Now, you said you had an opinion on the subject; what is your opinion as to the point?

A. Of course, it is a continuous process, and no one can say it has reached a definite point, but we know the Passaic River to be in a very putrescible condition and we know the other end of the system to be in pretty fair condition, so that somewhere in the passage down Newark Bay we might assign as the point where stability is approximately reached.

Q. Somewhere in Newark Bay?

A. Yes.

Q. And that point, in your opinion, would not have been reached at the Passaic River?

A. No, certainly not.

Q. You have not investigated the oxygen contents of the river water at the mouth of the Passaic River?

A. Only in the case that I have testified to at Newark.

Q. Is that the mouth of the Passaic River?

A. No, not at the mouth at all.

Q. That is what I asked you; have you made any tests there?

A. No, I have not.

Q. Do you know what the condition of the water is from any information that has come to your ears?

A. Why, from my general information, acquaintance with such matters, I can give a pretty good guess what the condition is.

Q. Well, I asked you if you had any information as to
4043 the conditions there, not what you guessed?

A. No.

Q. What?

A. No.

Q. You can't give any information on the subject?

A. No.

Q. How do you explain the conditions, the superior conditions, of the waters of the Kill Van Kull as compared with those at Robbins Reef?

A. The proportion of pure tidal water that enters Newark Bay—the relation of the volume of that water to the volume of polluting material is greater than the similar relation in New York Harbor.

Q. Where does that pure tidal water come from?

A. It flows through the Kill Van Kull, and somewhat partly through the Arthur Kill, and the Hackensack River.

Q. Is that tidal water, the Hackensack River?

A. No.

Q. What is it?

A. Fresh water.

Q. Then it is not tidal water, from the Hackensack River?

A. No.

Q. What percentage of the tidal water comes through the Kill Van Kull?

A. Why, I cannot state in exact figures, but approximately 75 per cent, in my recollection.

Q. And that is water from where; where had it passed through; what bodies of water had it passed through?

A. Through the Narrows.

Q. What else?

A. Lower part of Upper New York Bay.

Q. Part of the New York Bay waters, was it?

A. Some of the flood waters entering the Kill Van Kull had come from New York Bay on a previous ebb.

Q. And been subject to the pollution of New York Bay, had it?

A. Yes, that part had.

Q. What part had not?

A. The part which enters from the ocean directly and by far the larger part had not.

Q. How does it reach the Kill Van Kull from the ocean direct?

A. Through the Narrows.

Q. Jumps over New York Bay, does it, into the Kill Van Kull?

A. No.

Q. Well, does it pass through New York Bay?

A. Passes through the lower Bay.

4044 Q. Does it pass through the Upper Bay?

A. The lower portion passes through the Upper Bay, as I have stated.

Q. How much of that is it—that is the portion that comes through the Arthur Kill; how much is it?

A. What percentage of the total flood flow enters the Arthur Kill?

Q. Yes?

A. Well, if you want the exact figures, I shall have to get the Metropolitan Sewerage report. I will give my best judgment on the matter if you want it.

Q. I don't want your judgment; I want your recollection, if you have any?

A. About 81 per cent of the water flowing through the Kill Van Kull on the flood tide will come directly from the lower Bay, and the remainder will have come from the outer ocean by Sandy Hook.

Q. Well, now, the 81 per cent from the lower bay, by what course does it reach the Kill Van Kull?

A. Immediately around the shores of Staten Island.

Q. Through the New York Bay?

A. Through the Upper New York Bay.

Q. Through the Upper New York Bay. Why do you say it comes directly along the shore of Staten Island? How do you trace it so near Staten Island as that?

A. Well, because that is the channel, that is where the water runs.

Q. It is through the channel it comes, does it?

A. Yes.

Q. That is 81 per cent; and subjected, is it, or is it not, to the polluting influences of the waters of the Upper New York Bay?

A. Well, in so far as it is on that particular tide; on some previous tide that water may on some previous tide have been in part in the Upper Bay, but as it goes from the Lower Bay to the Kill Van Kull on the flood tide, all waters moving up are not at that time subjected to anything except some possible discharge along Staten Island.

Q. You think that the incoming flood tide comes in a fresh and unpolluted volume up the Kill Van Kull, do you?

4045 A. I would hardly call it either fresh or unpolluted, but I think I have stated what I mean. It comes without any influence.

Q. I will have to ask you to state it over again. Is the water flowing into the Kill Van Kull on the flood tide water that has been in the Upper New York Bay or not?

A. Well, in part it is.

Q. Well, to what extent is it water that had already been in the Upper New York Bay?

A. In order to answer that, I will have to trace it back through two or three days. I have told you what percentage came from the Lower Bay; now I will have to give you what percentage came from the Upper Bay on the previous tides. I can give you those figures. Of that 89 per cent of water which came from the Lower Bay into the Kill Van Kull on the flood tide, 83 per cent had been in the Upper Bay on the previous ebb tide; 7 per cent had been in the Hudson River on the previous ebb tide; 7 per cent had been in the East River on the previous ebb tide; and 1 per cent had been in the Kill Van Kull on the previous ebb tide.

Q. How do you account for that water being better than the water of the Upper New York Bay, then?

A. Largely because of the 19 per cent of water that had never been anywhere except in the ocean.

Q. And how had that 19 per cent reached the Kill Van Kull?

A. By flowing up on the flood tide through the Lower Bay.

Q. And then where?

A. Then through the lower part of the Upper Bay into the Kill Van Kull.

Q. So that the waters of the Kill Van Kull receiving the flood tides through the Upper New York Bay, in your opinion are higher and better in quality than the waters of the Upper New York Bay; is that so?

A. That expresses the act, but it is put in rather an unfortunate light.

Q. Now, the water that comes in by way of the Arthur Kill; what is the condition of that water, if you know, as to pollution?

A. The waters of the Arthur Kill—no, I don't know; that does not enter the problem. I have never given that any thought.

Q. Never examined the Arthur Kill?

A. No.

4046 Q. Do you know that the joint sewer outlet discharges at Elizabeth into the Arthur Kill?

A. I know there is a lot of sewage there.

Q. Do you know that the Arthur Kill is very highly polluted; do you know that, in a general way?

A. Yes.

Q. Do you think that the discharge of that water into the Kill Van Kull serves to refresh it?

A. No.

Q. How long is Newark Bay?

A. Nearly 10 miles, I should say.

Q. Newark Bay is nearly 10 miles long; do you think so?

A. I could tell you exactly if I had a good map; this map (indicating) does not show a very good scale.

Q. Have you never been on Newark Bay?

A. Yes.

Q. Don't you know that it is not 10 miles long?

A. No.

Q. Never navigated it?

A. I have sailed up and down it, but I have never measured it.

Q. How far is Elizabeth from Newark?

A. I don't know; I am not a geographer.

Q. Well, you have been in that country, haven't you?

A. Oh, yes.

Q. Well, have you no judgment as to the distance between Newark and Elizabeth?

A. Why, I suppose I could guess, if it was of value to you.

Q. No, I don't want you to guess?

A. Well, I have not any knowledge.

Q. Do you think it is 10 miles?

A. I don't know.

Q. I asked you whether you thought it was?

A. You said you did not want me to guess.

Q. I am asking you whether you think it is 10 miles?

A. I don't know; I don't think; I have not any idea how far it is.

Q. Well, do you think Newark Bay is 10 miles long?

A. Well, it looks to me on this map as though it might be 10 miles long.

Q. Well, looking back at your recollection of it, do you think it is 10 miles long?

A. I do not care to express any other opinion.

4047 Q. Do you think it is 2 miles long?

A. I said I thought it was 10 miles long.

Q. You said looking at that map you thought it was 10 miles long. Now, I ask you whether you really think it is 2 miles long, from what you know of it?

A. I don't know how long it is.

Q. Well, why do you say the conditions through the purification of the sewage in Newark Bay are superior to those in New York Bay; you said that?

A. Yes.

Q. Well, why do you say it?

A. Because of the possibilities of aeration which exist there, which do not exist to a corresponding extent in New York Bay, because of its greater depths.

Q. Well now, in what do the greater possibilities of aeration in Newark Bay depend?

A. A million gallons of water—any volume of water, exposed in a shallow depth will absorb oxygen from the atmosphere at a much greater rate than when exposed in deep depths. That rate is such a very important function of the depth that when we get to a depth of 20 or 40 feet the absorption on the bottom layers is practically nil.

Q. Has the surface of the water anything to do with the power of aeration?

A. It is entirely a surface function.

Q. Then does not the length of Newark Bay have some importance in determining the factor of aeration?

A. Not at all; it is merely the depth.

Q. Well, how do you arrive at the surface of a body of water; how do you reach a conclusion in figures as to the number of square feet in a surface of a body of water? You have got to know the length of the body, haven't you?

A. Yes.

Q. Well, do you know the length of Newark Bay?

A. No.

Q. Do you know the breadth of Newark Bay?

A. No.

Q. Do you know the area?

A. No.

Q. Has the area got anything to do with the power of aeration?

4048 A. No, not per million gallons of water. I expressed my rates of aeration in the million gallon units. I don't care how big the area is.

Q. Where does the water get its dissolved oxygen?

A. It gets it originally from the atmosphere.

Q. It depends on the surface contact with the atmosphere, does it not?

A. Yes, and the falling of rains.

Q. And when you go below the surface, not having any contact with the atmosphere, there was no absorption, isn't that it?

A. No, that is not so.

Q. How does the absorption take place below the surface?

A. The layer next below the absorbing surface absorbs it from that; there is a migration of oxygen downward.

Q. There is a diffusion of the oxygen is that it?

A. That is it exactly.

Q. You do not mean to say the lower strata of water takes any oxygen directly from the air, do you?

A. No, I did not say that.

Q. Well, I asked you if you mean to be understood as saying it?

A. No.

Q. Did you express any opinion as to the condition of the river water at the mouth of the Passaic River?

A. I did not in my direct testimony. I would not be answerable for what I said, in cross.

Q. Why wouldn't you?

A. Because I have no recollection—being through so much.

Q. Well, have you any opinion as to the condition of the river water at the mouth of the Passaic River?

A. Yes, I have a distinct opinion.

Q. What is your opinion as to its condition with reference to oxygen?

A. On the ebb tide, when we are getting a real river water there

its condition with reference to oxygen is very low indeed, practically zero in the summer, and perhaps 30 to 50 per cent in winter. On the flood tide, of course, we have the Bay water there, which will improve conditions somewhat.

Q. Well, now, this river water on the ebb tide, by the time it has passed through the Newark Bay, has been raised a very considerable extent in oxygen, has it not?

A. Yes.

4049 Q. You don't know the distance?

A. No.

Q. Of travel?

A. No.

Q. If you discharged the same amount of sewage at Robbins Reef, untreated, how far would it have to travel, in your judgment, before it had become practically nullified in its effect upon the oxygen in the Upper New York Bay?

A. In the direct line, only counting one trip over, it would travel somewhere up above the upper limits of New York City, but it would actually make that trip some half dozen times before it got out of the Harbor; so that the actual distance travelled would be much longer than that.

Q. How long a distance is that?

A. Well, that looks like about 10 miles also on the map.

Q. 10 miles also on that map, yes; so that the same sewage discharged at Robbins Reef in New York Upper Bay, in your opinion, will travel before it reaches a point of stability equal to that of the river water of the Passaic River a distance of 10 miles, is that it?

A. That would be the actual stream distance covered, but it would vibrate back and forth in that period a long while.

Q. Does it vibrate back and forth in the Newark Bay a long while, or doesn't it?

A. Yes. I have no doubt it does about the same.

Q. Well, don't you know as a matter of fact that it vibrates longer?

A. No.

Q. Do you know anything about it as a matter of fact?

A. Yes.

Q. Well, what is the relative length of time of the final discharge of water, discharged into Newark Bay at the mouth of the Passaic River, before it reaches the Kill Van Kull?

A. I don't know that; I don't know how many tidal oscillations there are.

Q. Isn't it necessary in order to determine how long it will remain in the Newark Bay to know the number of tidal oscillations?

A. No, because I did not find it necessary to find how long it remained in Newark Bay.

4050 Q. Well, I thought you said you knew it would remain about as long there as it would in New York Bay, didn't you say so?

A. That is just my opinion, just now; I have not thought of that before.

Q. Well, now, if the sewage discharged from the Passaic River into Newark Bay is purified to the extent to which you testified, by the time it reaches the Kill Van Kull it happens that the distance is only about 3 miles, how do you account for the greater rapidity of purification in the Newark Bay as compared with what you believe will be the effect of the discharge into New York Bay of the same sewage, at Robbins Reef?

A. The shallower depth of water in Newark Bay is a very great aid to aeration. That is the only single factor that makes the work go on more rapidly there.

Q. And therefore it is safer and better means of sewage discharge to discharge it into shallow water than it is into deep water?

A. As far as the aeration is concerned, it is very much more desirable.

Q. Well, has dilution any part in the process of sewage disposal, in your opinion?

A. Yes, it has everything to do with it.

Q. Everything to do with it? Well, assuming the discharge of the same sewage in the same quantity at Robbins Reef as is now discharged at the mouth of the Passaic River into Newark Bay, do you think that the effect of that sewage will be as far-reaching in New York Upper Bay as it is in Newark Bay?

A. Yes, I think it will produce much more serious results.

Q. In what respect?

A. In respect of lowering the average dissolved oxygen contents of the water.

Q. Well, how will that happen when you take into consideration the much greater diluting power of the New York Bay?

A. Because the sewage, that would come to New York Bay as sewage, whereas it reaches Newark Bay, a large part of it after a long travel in the Passaic River, and has carried out a large part of its oxidizing reaction before it ever reaches the Bay. That is one effect. Another factor is——

4051 Q. (Interposing.) Well, I asked you to assume the same sewage?

A. Oh, assuming that that sewer discharged into Newark Bay?

Q. Yes?

A. Oh, I think that would do more harm in Newark Bay to discharge the sewage itself there at one point.

Q. Well, given the same condition of the discharge of treated sewage, do you think it is safer to discharge it into Newark Bay or New York Bay?

A. How treated?

Q. Treated in the same way; the effluent is to be the same effluent, the sewage being the same, and subjected to the same processes of treatment? Do you think it is safer to discharge sewage into Newark Bay or New York Bay?

A. Well, there are lots of processes of treatment; I don't know what you mean by the same process of treatment.

Q. You can assume any process of treatment that you see fit, only the effluent must have been the result from the same process?

A. Well, if it were purified on sand filters, it would not make any difference where it was discharged; it would not do any harm any way.

Q. Then the effluent would be harmless wherever it was discharged?

A. Practically.

Q. Suppose it was subjected to the treatment which will remove 10 per cent of the putrescible matter, measured on an absolute scale, do you think that that effluent could be more safely discharged into Newark Bay or into New York Bay?

A. I should think that would probably work more harm in Newark Bay.

Q. And why; why do you think that?

A. Because there would be the greater concentration of sewage there which would more than offset the greater oxidizing power of the Bay.

Q. Well, the greater oxidizing power of Newark Bay upon a given body of sewage results, does it not, from the fact that the percentage of surface is larger to the total contents than it is in New York Bay?

A. Exactly, yes.

4052 Q. And that in the ultimate oxidization of the sewage, that percentage is an important factor; that is all you mean by your testimony, isn't it?

A. Yes, exactly.

Q. And in your testimony, are you not assuming that it is important or necessary to oxidize all of the sewage discharge?

A. Well, sooner or later, that must take place, naturally.

Q. Well, so far as the problem of local influence is concerned, if the sewage is carried out to sea after a definite length of time, is it a matter of importance?

A. No, the problem ends there, if it gets out to sea and stays there.

Q. Well how long does it take for any particular body of water to be discharged from the upper New York Bay into the sea; how many tides?

A. Why, six or seven tides on the average, from the point opposite here.

Q. Now, if the sewage matter discharged into New York Bay, the Upper Bay, is held in suspension for the length of time necessary to discharge it into the ocean, what injury is going to be done by it?

A. It reduces the dissolved oxygen of the stream.

Q. Well, what importance has the dissolved oxygen, in your opinion?

A. The dissolved oxygen prevents the production of offensive conditions, odors, principally, and unsightly conditions, such as we have in the Passaic River.

Q. Well, in other words, it is important in taking care of sewage, is it not chiefly?

A. I would hardly state it that way; it is important in keeping the physical characteristics of the stream up to the standard.

Q. Well, now, what are those physical characteristics of the stream so far as they are applicable to Upper New York Bay which have an importance, except the digestion of sewage?

A. Why, the appearance is a very important matter. I don't think the Passaic River is a pretty thing to look at; it certainly would be a serious matter if New York Harbor got into that condition as to the appearance. The odors are an even stronger

argument.

Q. Well, these conditions which you say are objectionable, and which are objectionable, do they arise in any other way than from the discharge of sewage?

A. No.

Q. And the dissolved oxygen, therefore, is important, is it not, in digesting the sewage which is discharged into the Bay, and chiefly for that?

A. I don't admit that point of view at all.

Q. Well, what else is of importance?

A. The sewage pollution reduces the dissolved oxygen, and the reduction of dissolved oxygen is coincident with nuisances in the stream. But I would not reverse the argument and say that the only advantage of dissolved oxygen was to purify sewage.

Q. Well, outside of being an indication of the presence of large quantities of sewage pollution in the waters what other important thing does the reduction of the dissolved oxygen in the water indicate?

A. That is all it indicates.

Q. That is all it indicates; and it is therefore a standard or scale showing the pollution of the water, is it not?

A. Yes, when properly interpreted.

Q. Well, outside of that function of sewage digestion or digestion of polluting matter in the waters, what other functions do you understand the dissolved oxygen has so far as the waters are concerned?

A. It supports fish life.

Q. What else?

A. A water which was devoid of dissolved oxygen—if one could conceive of that situation without sewage pollution, would be odorous of itself. The natural decay of organic matter, namely, vegetable life, within it would set up nuisance conditions.

Q. Well, that certainly would not continue for any considerable length of time, would it?

A. I think a water devoid of oxygen without any sewage pollution whatever would be a very unpleasant thing.

Q. At what point, do you think, in the reduction of oxygen will that occur?

A. Well, it would not be necessary to go clear out, but they get conditions in old cisterns where they used to store the roof water, where the fermentation of microscopic plants

and animals reduce the dissolved oxygen, and they get the characteristic, distinctly unpleasant odor of cistern water.

Q. Well, now, Professor, you have testified as to malodorous conditions, and what in your opinion will result on certain things being done on New York Harbor, and what are those things you believe would produce malodorous results on the shores of New York?

A. The specific chemical compounds?

Q. No, I am referring to your testimony that a discharge of certain sewage would result in malodorous conditions; do you remember testifying to that?

A. Yes.

Q. What was that sewage that you had in mind?

A. I had in mind the sewage as I conceive it will be constituted, that it is proposed to discharge at Robbins Reef Light.

Q. Well is that sewage treated or to be treated in any way?

A. Treated according to the proposal, by screening and sedimentation.

Q. And you have testified to having read the testimony of Mr. Johnson—George A. Johnson. You did read it I suppose?

A. Yes.

Q. You recall the fact that in his opinion that result will not be reached?

A. Yes.

Q. You don't agree with him?

A. No, I do not.

Q. That is all you mean to be understood as saying, isn't it?

A. Yes.

Q. You understand that the stipulation which is Complainant's exhibit No. 135 was adopted by the Government representatives, the United States Government representatives, including Mr. Black, or Colonel Black?

A. Yes.

Q. You understand that in his opinion the result will be the result guaranteed, do you?

Mr. O'Sullivan: That is objected to.

The Commissioner: Note the objection of Counsel for the Complainants.

4055 The Witness: A. No.

Q. You understand that he approved of those specifications in that stipulation, don't you?

A. Yes.

Q. And you do not understand that he believed that that result would be reached by the processes that are enumerated in that stipulation?

Mr. O'Sullivan: I object to Colonel Black's belief; it is not in issue here. It has been neither testified to nor put in issue in any way.

A. I know that Colonel Black's personal opinion is that that result will not be reached by these proposed works.

Q. And you know that, do you?

A. Yes.

Q. And nevertheless he was responsible—do you know he was responsible for this stipulation?

A. He was not supremely responsible, nor were the specifications that were finally adopted his original recommendations to the Secretary of War.

Q. Well, didn't he approve of them and recommend them?

A. Not in the form in which they were finally adopted.

Q. You are sure of that, are you?

A. Yes sir.

Q. What additional specification was there in Colonel Black's recommendation which is not in this stipulation?

Mr. O'Sullivan: Objected to.

The Commissioner: Note the objection.

A. His original recommendation contained a clause in addition to those that were finally accepted that the putrescibility of the sewage measured by certain specified standards should be reduced by a stated amount. I have forgotten the exact figure, but my recollection is 75 per cent before discharge.

Q. It should be reduced to 75 per cent?

A. Yes.

Q. Are you familiar with the stipulation in the Bronx Sewer Case?

A. Yes I am.

Q. Do you remember how much that putrescibility was agreed to be reduced there?

A. There was a time-sliding scale there; I have forgotten the details of it. It started in rather light and got more and more severe.

Q. Well, what did it start in at?

A. I don't know.

Q. Don't you know it was 10 per cent?

A. I don't remember.

Q. Do you think that Colonel Black undertook to establish a 75 per cent reduction in putrescible matter?

A. That is the best of my recollection of his original report.

Q. Well, can the putrescibility of sewage be reduced 75 per cent?

A. Yes sir.

Q. By what process?

A. By filtration.

Q. What kind of filtration?

A. Through trickling filters.

Q. Well, when you testified as to malodorous conditions being produced by the sewage, did you have in mind the guarantees in the stipulation between the United States and the State of New Jersey as have the results guaranteed when discharged at Robbins Reef?

A. I had them in mind, but they do not influence me. They do not influence my mind as to what will happen.

Q. You are not influenced by them in any way?

A. No.

Q. You do not believe that an effluent can be produced that will have the results guaranteed when discharged at Riddions Reef?

A. Not by the method that is proposed.

Q. Well, what method do you understand is proposed?

A. Screening and sedimentation.

Q. Nothing else?

A. That is all.

Q. How do you reach that conclusion?

A. That is in the stipulation.

Q. What else is in the stipulation?

A. That is all I recollect.

Q. You do not recognize any additional, lawful appliances or methods as having been contained in the stipulation?

A. There is that general clause, but it does not mean much.

4057 Q. It does not mean much?

A. No.

Q. Well, will you tell us why it does not mean much, in your opinion?

A. Because it is too indefinite. I don't know what a lawful appliance is.

Q. You are troubled with the interpretation of the word "lawful"?

A. Why, that in part, but the whole clause is exceedingly indefinite.

Q. Well, passing by the word "lawful" for the time being and assuming that the stipulation is that they shall introduce other appliances for purification, would that be too indefinite, in your opinion?

A. Yes.

Q. Why?

A. Because when these works are completed, and it is found out that they do not come up to the specifications, if that is the case, there seems to be no way provided in the contract by which anyone shall determine what other measures are necessary, and the whole thing is left in such an indefinite way it does not seem to me it can be enforced at all.

Q. Well, your doubt is as to the ability of the United States Government to enforce the stipulation, is that it?

A. Not of the United States Government, but my doubt is of the ability and the enforceability as to that contract as it reads.

Q. Well, have you any doubt that an effluent can be produced which will meet the guarantees of the stipulation?

A. Well, taken literally, I don't think an effluent could be so produced; but interpreted in a liberal way, I think those requirements can be essentially met.

Q. You said that there could be an effluent produced which would be safe to discharge anywhere, as I remember your testimony?

A. Yes.

Q. Well, don't you think that effluent which you have said could

safely be discharged anywhere could produce the guaranteed results if discharged at Robbins Reef?

A. Those results are pretty fine. An effluent which would be safe to discharge anywhere, for example, might contain some suspended matter, visible suspended particles, but this guaranteed result states that the effluent shall not contain any visible suspended particles.

4058 Q. Taken in the liberal sense, then, if you want to distinguish, do you think an effluent can be produced which could result in the guaranteed results?

A. Yes, undoubtedly.

Q. What processes do you think will be necessary to apply to the sewage which are not particularly described in the stipulation in question?

A. I don't think anything less than a sand filter would come at all within the stipulation.

Q. Yes, well, that is feasible, isn't it?

A. I hardly want to say that it is feasible; it would be a tremendous undertaking. Of course it could be done.

Q. It could be done?

A. But hardly feasible from an engineering standpoint.

Q. But could it be done?

A. It could be done.

Q. Well, having been undertaken to produce the effluent by the means described or by other lawful appliances do you have any doubt that that is a lawful appliance?

A. I suppose a sand filter is a lawful appliance.

Q. What in your opinion, is the difficulty then, with the United States Government enforcing its stipulation against the State of New Jersey?

A. There is merely the very great difference between what is conceivably possible and what is feasible or practical from an engineering point of view. It would bankrupt the communities, and they would not do it.

Q. Well, Professor Phelps, do you think it is desirable to continue the discharge of the sewage into the Passaic River?

A. No, not at all.

Q. What is going to be done with it?

A. Why, my solution would be for each to solve their own problem. Purification methods are available by which they could get out of it a lot cheaper than down at Newark.

Q. That is a question of economy, is it not?

A. Yes, entirely of economy.

Q. The same processes that would produce effluents that could be discharged into the immediate streams of the municipalities, when applied to the general sewage collected on the Newark
4059 Meadows would produce an effluent which would be discharged into the Newark Bay?

A. Well, the problem is complicated by the age of the sewage, but practically that is so.

Q. Complicated by the additional age of the sewage. Do you think it is even more economic to establish separate disposal plants than to have a combination one?

A. Very much so.

Q. You find that so in actual practice, do you?

A. Yes sir.

Q. Why?

A. Because in the first place it saves a very heavy expense, and interest charges on a trunk sewer. In the second place it is possible to find small places adapted for sewage disposal, where it is not always easy to find large ones. Your nuisances are always lessened on a small plant.

Q. Well, you are familiar with the territory of the Passaic Valley, are you?

A. I am not very familiar with that country, no.

Q. You have been up and down the Passaic River?

A. Yes.

Q. And Newark Bay?

A. Yes.

Q. Where is the place that you selected for the City of Newark?

A. I have not considered that matter in sufficient detail to decide.

Q. Well, you know that a very large percentage of the sewage is produced in the City of Newark, don't you?

A. Yes; I understand that is the case.

Q. And you recognise the necessity of giving that some treatment?

A. I certainly do. Although that is the least important of the lot.

Q. That is the least important, is it?

A. Because they have the Bay to discharge into.

Q. What Bay have they to discharge it into?

A. Newark Bay.

Q. Do you think they could safely discharge their sewage into Newark Bay?

A. I think they could for some time to come without producing serious nuisance.

Q. And still you think the additional discharge of the sewage of the Passaic Valley above that contributed by the City of Newark into New York Bay would create a nuisance, do you?

4000 A. Taken on top of what we have now, it would certainly do so; it would not alone.

Q. The trouble with New York Bay, in your opinion, is what New York City is doing, is it?

A. It is the present condition.

Q. And New York City has practically rendered the waters of New York Bay a nuisance, has it not?

A. Practically, yes sir, in conjunction with other cities that have taken part in it.

Q. Well, you think that the discharge of the effluent from the works as described in the stipulation at Robbins Reef will be per-

capable in the face of and under the conditions of nuisance that have already been created by New York City?

A. Yes sir, very distinctly.

Q. How, and where?

A. By greater reduction in dissolved oxygen in all parts of the lower Harbor and Hudson and East Rivers.

Q. Well, in what other respects?

A. Greater evolution of offensive gases, and general unpleasant appearance of the waters.

Q. Did you say how much you thought the oxygen in the New York Bay would be reduced by the discharge of the sewage of the Passaic Valley?

A. I have estimated that in the Upper Bay it would be reduced to 40 per cent.

Q. It would be reduced to 40 per cent?

A. Yes.

Q. What is the actual reduction that you figure on by the introduction of this sewage at Robbins Reef?

A. About 25 on the average.

Q. 25 per cent?

A. It is from 35 to 40.

Q. Well, assuming saturation, what would be the reduction, in your opinion, from the introduction of the Passaic Valley Trunk Sewer at Robbins Reef, treated as described in the stipulation?

A. You mean assuming that the water was saturated at the start?

Q. Yes?

A. About the same amount.

Q. About 25 per cent?

A. Yes.

Q. If one of the witnesses for the Complainants has testified that in his opinion the reduction would be 7 per cent, you do not agree with him?

A. No, not at all.

Q. You know that a witness did testify to that, do you not?

4061 A. No, I do not know that.

Q. What is the amount that you are figuring on as to the quantity of sewage?

A. That is the ultimate amount.

Q. 360 million gallons per day?

A. Yes.

Q. How much sewage is discharged into New York Bay at the present time from the City of New York?

A. I have kept that in terms of population; I cannot give it in gallons but figuring on contributing population of about 4,000,000 people.

Q. That is the present contributing population?

A. Yes.

Q. Do you know what the present contributing population of the Passaic Valley is?

A. I have not those figures in mind.

Q. What is the ultimate contributing population which is to produce this 360 million gallons, if you understand it?

A. Between 2 and 3 millions, I understand it.

Q. 2 or 3 million people in 20 years in the Passaic Valley; you understand that to be the estimate do you?

A. Yes.

Q. Would you have to revise your figures if the estimate is 1,500,000?

A. I have a habit of making my calculations on actual population, and not on sewage flow, and I am trying to convert my sewage flow into population. I have not those figures very clearly in mind.

Q. Well, given three times the population in New York City—three times the population as is estimated to produce 360 million gallons of sewage, and discharging that directly into New York Bay, what in your opinion will be the reduction in the oxygen contents or dissolved oxygen of that sewage? Would it be three times that you estimate from the Passaic Valley?

Mr. O'Sullivan: When?

Mr. Riker: At any time.

A. I don't quite catch your meaning, given three times what estimate?

Q. If the population of the City of New York at the 4062 present time is three times the estimated population of the Passaic Valley 20 years from now, is there any reason why the reduction of free oxygen in the waters of Upper New York Bay should not be three times the amount that you have estimated for the discharge of 360 million gallons of sewage from the Passaic Valley?

A. Yes, a very great reason.

Q. What is the reason?

A. That reduction of dissolved oxygen is not such a simple direct ratio as you have indicated. The additional application of sewage to the water depresses the oxygen level and that depression calls for increased aeration, so that continuous addition of population makes a less proportionate reduction in dissolved oxygen. That is, theoretically we never could get it all down, there would always be some aeration which would be a factor, and there would always be some oxygen.

Q. Well, in other words, a discharge of 360 millions of gallons of sewage from the Passaic Valley, in your opinion, will reduce the oxygen contents 25 per cent, and the discharge of the sewage from three times the population living in New York City will not reduce it any more, is that it?

A. No, it will reduce it a good deal more, but not three times as much.

Q. Well, how much will it reduce it, or ought it to reduce it if the reduction in the Passaic Valley sewage under those conditions is 25 per cent, and how much in your opinion ought the discharge from three times the population living in New York City reduce it?

A. It is a very elaborate computation to figure what that would be.

Q. I don't want it exactly; give me an approximation?

A. I have made some computations here (indicating) for certain populations. We have some computations here based on an assumed population of $4\frac{1}{2}$ millions, which is very close to your question, and it gives us in various parts of the Harbor oxygen saturations of from 40 to 75 per cent.

Q. Those are actual determinations, are they not?

A. No, those are all computations; they agree fairly closely, however, with the determined values.

4063 Q. Where was the reductions to 40 found?

A. 40 was in the Harlem River.

Q. Well, have you got any in the Gowanus Canal also there?

A. No.

Q. Where is the 75 or whatever you say it was?

A. 75 is in the Upper Bay, on the flood.

Q. And you say that the introduction of the 360 millions of gallons of sewage of the Passaic Valley at Robbins Reef will reduce the average oxygen contents in the Harbor 25 per cent?

A. In the Upper Bay.

Q. In the Upper Bay?

A. Yes.

Q. That is the sewage of the 4 million and a half population of New York City will reduce the average oxygen contents 25 per cent in the Upper Bay?

A. Almost exactly, yes.

Q. Well, how do you account for the fact that three times the population only reduced the average oxygen contents the same amount?

A. The sewage that we have calculated or estimated here is distributed all about these waters, largely in the East River, and considerable portion of it goes out through Long Island Sound, and has a very much greater dilution factor, than would be obtained by discharging at Robbins Reef. The computations are made on exactly the same assumptions as formerly.

Q. How much of the sewage goes out through the Long Island Sound?

A. This is a little complicated. I will try to give it to you. About 20 per cent of all the sewage which reaches the area between Hell Gate and Throggs Neck. That includes the drainage of all the Flushing area, and a large portion of the flow of the Harlem River leaves the river into the Sound at the end of the ebb tide and about 50 per cent of the sewage which is discharged into the East River between the Battery and Hell Gate gets into that area I first mentioned during the ebb tide, so that 20 per cent of that 50 per cent is discharged on the next ebb.

Q. So that in your opinion so far as the general condition of the Harbor or Upper New York Bay is concerned, it is rather advantageous to discharge the sewage as it is now being discharged right

along the shores as compared with discharging it out into
4064 the deep water at Robbins Reef, for instance?

A. I would not care to be responsible for that opinion, no, sir.

Q. Well, doesn't that explain the fact that three times the amount of population only produces a reduction in oxygen that you have estimated from the discharge of the Passaic Valley sewage at Robbins Reef?

A. No, I do not think you have got the point at all.

Q. Well, will you explain the point, Professor?

A. The particular point is that instead of discharging the sewage all at one spot, at a place where it will be carried up into the weakest part of the system, namely, the lower Hudson River, under the present conditions it is discharged at hundreds of outlets, and is diluted into the tidal water at each tide, also at such points that a considerable portion of it gets out through Long Island Sound, or subjected to the purifying action of fresh water coming in from Long Island Sound. It is that general distribution of the sewage all about the system rather than putting it into one spot that produces that effect.

Q. And you are bearing in mind that there has been some reduction in putrescibility by the treatment that is to be given to the Passaic Valley sewage as you understand the stipulation?

A. Why, I testified that I don't think that reduction will materialize.

Q. You don't think there will be any reduction?

A. No.

Q. You don't think that the reduction of the suspended matters by sedimentation will reduce the putrescible matter at all?

A. No.

Q. Did I understand you rightly?

A. That is correct.

Q. Is there anybody that agrees with you in that position, that you know of?

A. I don't recall having discussed it with anyone.

Q. And you are not, therefore, assuming that there will be any removable of putrescible matter by the disposal specifically described in the stipulation in question?

A. I have tried to make that point clear in my testimony.

4065 Q. Well, answer it again then?

A. I will. I would distinguish between the removal of putrescible matter and the removal of putrescibility. There will be a removal of material there, but as I explained, there will be a compensating increase in putrescibility in what is left, which, judging by experiences elsewhere, will more than make up for that removal.

Q. And therefore, in your opinion, the effect of the sewage from the Passaic Valley sewer will be as great in the reduction of Oxygen in the waters of Upper New York Bay as the discharge of the sewage from the whole population of the Greater City of New York?

A. As that affects the Upper New York Bay, yes, sir.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Professor Phelps, you mentioned in relation to New York City's sewage that it was discharged at a number of points. I ask you whether that sewage is fresh, stale or septic at the time of its discharge?

A. It is exceedingly fresh.

Q. Is the consumption of oxygen by fresh sewage or by septic sewage greatest?

A. By septic sewage it is much greater.

Q. Which is the more rapid?

A. Septic sewage, old sewage.

Q. Is it a universal experience among sewage disposal operators that sewage is more economically and effectively treated near its source or origin?

A. That I think is the universal belief.

Q. Do you know of anyone who has proclaimed any different condition as the result of sewage treatment?

A. I have never heard of any.

Q. The sewage that you have been testifying to as proposed to be discharged by the Passaic Valley trunk sewer at Robbins Reef, at or near Robbins Reef Light, what condition will you expect that sewage to be in at the time of its discharge?

A. I should expect it to be distinctly septic without any dissolved oxygen, very much decomposed, broken up into fine material, black in color, and very malodorous.

4066 Q. When sewage is macerated by long transit and pumping, and attritions in a long sewer of transportation are the organic matters largely put into a condition to enter solution readily or not?

A. They are to a large extent actually dissolved, and where they are not dissolved they are rendered colloidal in nature. It is a semi-dissolved condition. In general they are rendered more readily oxidizable.

Q. Are they easily removed in that condition by sedimentation or screening?

A. No, they are not removed with any degree of efficiency whatever.

Q. What is the difference in the method of oxygen consumption by fresh sewage through biological agencies and septic sewage?

A. The difference is mainly one of rate of reaction. A septic sewage has been brought to a physical and chemical condition, where it is exceedingly active in its bio-chemical reactions and it is oxidized with much greater rapidity when brought into contact with oxygen than would be the case with the corresponding fresh sewage.

Q. When substances enter into combination with oxygen through chemical agencies, direct, and through biological agencies indirect, which is the more rapid process and which process will exhaust the oxygen content of the water into which such substances are discharged most rapidly?

A. The bio-chemical reactions are generally much more slower than direct chemical reaction, and in the case under discussion what

direct chemical reaction might take place would do so with very great rapidity. Hydrogen sulphide, for instance, would be oxidized directly by the oxygen of the water, and would result in an almost immediate reduction of dissolved oxygen.

Q. And after the oxygen content was reduced considerably then would the hydrogen sulphide escape into the air?

A. Well, that portion which had been oxidized would not.

Q. The un-oxidized?

A. The reduction of the dissolved oxygen would lead to a still greater production of hydrogen sulphide due to the anaerobic conditions established.

4067 Q. Is hydrogen sulphide the product of aerobic or anaerobic functional activity?

A. Anaerobic.

Q. When sewage is transported in a long trunk sewer, does that favor or disfavor anaerobic action?

A. That favors it.

Q. Favors which?

A. Anaerobic action.

Q. Mr. Riker asked you questions relative to the volume of New York City sewage. Did you take into consideration in estimating the measure of pollution of New York's Upper Bay the amount contributed by the riparian cities in New York Bay to that pollution, as well as the amount of pollution contributed by New York City?

A. I think that figure of practically $4\frac{1}{2}$ millions was a contributing population to the particular bodies of water that we have under discussion. Of course there is a considerable contributing population within the boundaries of New York City that do not contribute to this Bay.

Q. What cities in the State of New Jersey are riparian and contribute sewage to New York Upper Bay?

A. I shall have to stop at Hackensack; I don't know anything about that. There is Hackensack and Bayonne.

Q. Hoboken?

A. Hoboken, yes.

Q. In estimating the ultimate capacity of the trunk sewer at 360 million gallons of sewage a day you mentioned in reply to a question put to you by Mr. Riker that you had found that a volume of sewage contributed by the silk factories of Paterson had been eliminated from the computation of sewage and trade wastes to be carried in the sewers. What did you estimate the per capita of that item of sewage alone which had been eliminated to equal?

A. 200 gallons per capita per day for the entire population of Paterson.

Q. And they had failed to take that into consideration, had they?

A. That I understand is not included in the 360 millions.

Q. In answering questions of Mr. Riker on the condition of the Passaic River and its oscillations, do you regard the Passaic River as a septic tank?

4068 A. Yes, sir; in the summer time I think that is a very fair name for it.

Q. What is a septic tank?

A. A septic tank is ordinarily a basin or tank in which sewage is held, and in which certain reactions, sedimentation, and biological reactions are allowed to take place. The flow through the tank is slow, and in that respect the Passaic River would not be an ideal septic tank, but in that river owing to the tidal backing up the flow is sufficiently stagnant or slow to allow sedimentation to take place and so we have the activities and reactions that would occur normally in a septic tank.

Q. Is that a purifying process for the sewage?

A. In one sense it is. In the sense that it is a step in the direction of purification, it is. But in the other sense if we consider the effluent from such a treatment directly, it is more offensive and in a much worse condition than fresh sewage.

Q. Well, carrying the simile along, do you regard the effluent which would gradually drift into Newark Bay as one which would be more readily oxidized in a shallow basin right near Newark Bay than if it had originally been discharged there instead of into the river?

A. Yes.

Q. Are shallow bodies of water more readily aerated and more affected by the wind in aeration processes than deeper bodies of water?

A. They are, very much.

Q. Irrespective of the areas of such bodies?

A. Yes, sir.

Q. Mr. Riker directed your attention to Complainants' Exhibit No. 135, Professor Phelps; have you studied the guaranteed results of the effluent proposed to be discharged at Robbins Reef?

A. Yes, sir.

Q. Do you believe it possible to secure such an effluent with the current described in that stipulation?

A. No, I do not.

Mr. O'Sullivan: I think that is all.

Recross-examination by Mr. Riker:

Q. Professor, do you think it is possible to produce an effluent which will result in the guaranteed results of the stipulation, Complainants' Exhibit No. 135?

A. Yes.

Q. Are you familiar with the disposal plants of Hamburg, Dresden and Frankfort?

A. Not from any personal observation.

Q. Do you know how far from the respective cities the disposal plants are located?

A. No, I do not.

Q. Do you know whether the sewage treated in those disposal plants is septic or not?

A. No.

Q. You know they have disposal plants, I suppose?

A. Why, at Hamburg they screen the sewage and I guess that is

all they do to it. I don't think they settle it. What are the other places, Berlin?

Q. Dresden?

A. I don't know about Dresden.

Q. Frankfort?

A. At Frankfort they have—they settle the sewage at Frankfort, screen it and settle it.

Q. And you do not know how far from the cities those plants are located?

A. No.

Q. You do not know whether they are as near or further away than the proposed disposal plant from the Passaic Valley with reference to the City of Newark?

A. No, I do not.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Do you know that sewage is fresh that is treated at all these three points?

A. I am most familiar with the Hamburg work, and I know that that is quite fresh, because the actual removal of material there includes a great deal of fecal matter which would be impossible in stale sewage. I am not sure about the other cases.

Mr. O'Sullivan: That is all.

Mr. Riker: That is all.

Adojurned to June 4th, 1913, at 10:30 A. M.

4070 Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COM-
MISSIONERS, Defendants.

Before James D. Maher, Esq., Commissioner.

NEW YORK CITY, JUNE 4th, 1913—10:30 a. m.

Appearances:

William J. O'Sullivan, Esq., Special Counsel for the People of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

HARRISON PRESCOTT EDDY, a witness in behalf of the Complainants, recalled in rebuttal, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Mr. Eddy?

A. Harrison Prescott Eddy.

Q. You testified in this suit previously?

A. I have, yes sir.

Q. Mr. Eddy, has your attention been directed to the testimony given by Mr. George A. Johnson, for the defendants, and as to that part appearing on page 3976 to and including pages 4010 and 4011?

A. It has, yes sir.

Q. Have you made a direct observation on sewage outfalls
4071 from submerged outlets, as to what becomes of the sewage?

A. I have, yes sir.

Q. Where?

A. I have made a number of such observations in Boston Harbor.

Q. How many sewerage districts are there discharging into Boston Harbor?

A. Three main districts.

Q. What are they?

Mr. Riker: The question is objected to on the ground that it is not rebuttal. It has been admitted and put into the record dozens of times that there are three outlets in Boston Harbor; it has not been controverted by anybody.

The Commissioner: Note the objection of Counsel for the defendants.

A. The outlet of the Boston main drainage works at Moon Island; the outlet of the North Metropolitan Sewerage Works in the vicinity

of Deer Island Light; the outlet of the South Metropolitan Sewerage Works in the vicinity of Peddock's Island, sometimes called the Nutt Island outlet.

Q. Which is the oldest of these plants?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The Boston Main Drainage Works.

Q. How is that discharged?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. The sewage is retained in large storage reservoirs for a period of about 10 hours during the day, and during the incoming tide, and part of the out-going tides. It is discharged twice daily, the discharge being made in the vicinity of the turn in the tide, so that the sewage discharged goes out on the outgoing tide. The discharge usually lasts about two hours after the turn of the tide.

Mr. Riker: Counsel for Defendants desires to ask counsel for the Complainants for what purpose these undisputed facts are again put upon the record.

4072 Mr. O'Sullivan: Counsel for Complainants, in reply would state that it does not make any material difference whether the discharge is at the surface, as is now being described by the witness, or from a submerged discharge of 30 feet, similar to the one proposed by the Passaic Valley Commission, and that in each and every case the sewage rises to the surface, and it gets no greater diffusion or dispersion by the proposed method of discharge of the Passaic Valley Sewerage Commission.

Mr. Riker: Counsel for Defendants again asks why it is necessary to put undisputed facts upon the record, a multiplicity of times for the purpose you have now indicated?

Mr. O'Sullivan: To avoid any confusion as to the ones that will be later discussed by this witness, it is necessary to show he is familiar with the method of discharge from each of the three systems before he discusses the one that is absolutely pertinent to the dye experiments to be refuted here.

Mr. Riker: That is not rebuttal.

Q. Mr. Eddy, where does the North Metropolitan Sewerage Works discharge?

Mr. Riker: The question is objected to upon the ground that this matter is already upon the record at least a dozen times and is not disputed, and is an admitted fact as to where it is discharged; and counsel is abusing the privilege of this examination by putting this question to this witness on rebuttal.

The Commissioner: Note the objection of Counsel for the Defendants.

A. The centre of the Deer Island Light.

Q. Is that the submerged outfall?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. It is.

Q. Where does the South Metropolitan Sewerage Works discharge?

4073 Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. About a mile and an eighth in a general northerly direction from Nutt Island, and about half a mile westerly from Peddock's Island.

Q. Is that a submerged outlet?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. That is a submerged outlet.

Q. Submerged to what depth?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. At low water it is at a depth of about 30 feet, at high water about 40 feet. This refers to the more easterly of the two outlets, the northerly outlet is submerged to 24 feet at low water, and to 34 feet at high water.

Q. Are both of these in use?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Under ordinary conditions, only the more easterly of the outlets is used. The westerly outlet is used at times of extremely high flow in sewers.

Q. What population is served by the South Metropolitan System?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. About 250,000.

Q. Have you observed the discharge of sewage from the Moon Island Outlet?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I have, many times.

Q. Have you observed the discharge at the Deer Island Outlet?

4074 Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I have on many occasions.

Q. What were your observations as to the effect of the sewage discharged from that outlet?

Mr. Riker: The same objection, and also by the fact that he has already testified on direct examination to this very question.

The Commissioner: Note the objection.

A. The sewage from this outlet comes immediately to the surface, forms a large sewage field, and a large sleek field. At times the sewage is very offensive, and is always, so far as my observation goes, easily detected, and covers a large area.

Q. Extending in length for about how far?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. When I sailed through the area last August, 1912, I estimated the length of the sewage field to be over a mile. The water was highly colored, dark brown in color, and was exceedingly offensive around and for some distance from the outlet. The odors were easily distinguished from the boat.

Q. What were the odors; how would you describe them?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Greasy sewage odor, which was offensive.

Q. Have you made observations at the Nutt Island outlet?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Q. I have on a number of instances, particularly on the 28th of July, 1911, on the 13th of September, 1911, on the 29th of May 1913, and on the 31st of May 1913.

4075 Q. Will you describe the Nutt Island outlet, its submergence and its comparable conditions with those proposed by the Passaic Valley Sewerage Commissioners?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The Nutt Island outlet is located in a northerly direction from the Nutt Island screen house to which all the sewage gravitates, and where the sewage is roughly screened. From this screen house the sewage passes through a cast iron submerged outfall pipe about 60 inches in diameter to the more easterly outlet, a distance 5,800 feet. This outlet is placed at or near the bottom of the Bay, and at low water is submerged to a depth of 30 feet. The outlet pipe is 50 inches in diameter.

Q. I see you consulting a blueprint, Mr. Eddy; what does that blueprint represent?

A. This (indicating) is a blueprint made up in my office under my immediate direction and oversight, and contains data and sketches taken from two record plans of Section 43 of the South Metropolitan Sewerage Works, Numbered sheets 1 and 2, dated November, 1904, and signed by William M. Brown, Engineer of the Sewerage Works.

Q. Who is William M. Brown?

A. He was at that time Engineer of the Sewerage Works.

Q. Do you know what he is now?

Mr. Riker: The question is objected to on the ground that it appears on the records by the same witness who Mr. Brown is.

The Commissioner: Note the objection.

A. Engineer of the Passaic Valley Sewerage Works.

Mr. O'Sullivan: I offer the blueprint described by this witness representing outfall pipes, the high level sewer of the South Metropolitan Sewerage Works, in evidence, and ask that it be marked Complainants' Exhibit No. 206.

Mr. Riker: The offer is objected to on the ground that the proposed exhibit has not even had the first element necessary #56 for its introduction proved.

The Commissioner: Note the objection.

Received in evidence and marked Exhibit No. 206.

Q. Did you perform any dye experiments at the Nutt Island outlet, and with the sewage discharged through the Nutt Island outfall?

Mr. Riker: The question is objected to on the ground that it is not rebuttal of any evidence introduced on the part of the defendants and should have been introduced in his main case if it is competent at all.

The Commissioner: Note the objection of Counsel for the defendant.

A. Yes.

Q. When did you perform these experiments, Mr. Eddy?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. One in July, 1911.

Q. What day in July?

A. What date?

Q. What date?

A. July 28th, 1911; two on the 29th of May 1913, and I was present when similar experiments were made on the 31st of June, 1913.

Q. Did you say June or May?

A. May I should have said.

Q. Will you describe the experiment of July 28th, 1911?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. On this date, in company with my partner, Leonard Metcalf, and an assistant, W. L. Butcher, and Professor Bonnett of the Worcester Polytechnic Institute, I took a tug in Boston Harbor, and sailed down to Deer Island, thence to Nutt Island. On that day there was an extremely high wind, and the very heavy down-pour of rain lasting throughout our trip on the Bay. At Nutt Island I procured a barrel and saw that it was filled with water

and the two pounds of eosine blue dye were introduced into the barrel and thoroughly mixed. At a specified time this dye was turned into the sewer, and I sailed to the outlet, and at the computed time or very close to it, I observed the dye coming from the outlet and easily visible on the surface of the Bay. At the same time there were large quantities of sewage matter, paper, fecal matter, fruit skins, matches and the general turbidity and discolor which goes with the sewer in the vicinity of the outlet. The water was extremely rough, so that there was a very good opportunity for mixing, diffusion and dilution of the sewage, but instead of this fact it was clearly discernible from the deck of the tug on which I was sailing. At about 10 minutes after the dye had been seen at the outlet, the area covered by the sewage field was in the neighborhood of 400 feet square. About 20 minutes after the dye had been first observed, the sewage field was approximately 1,200 feet long by 1,000 feet wide, and the color was faded. At 2.19 or about 30 minutes after I first observed the dye, the color had disappeared, and the visible sewage field as distinguished from the sleek field covered an area about 400 feet in diameter. Just as I was about to leave the street washings due to the storm reached the outlet and created a very large sewage field very much discolored being a very dark, dirty brown. This field could be seen for a considerable distance, I should say at least a quarter of a mile from the outlet.

Q. How deep was the submerged point of discharge on that occasion for both the sewage and the dye?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

The Witness: At that time the outlet was at about the depth of 30 feet below the surface of the water, high tide, according to the Government records, being at 1.20 P. M., and the observation of the dye being at 1.49 P. M., just about 30 minutes after high tide.

Q. Did you say 30 or 40 feet?

A. I should have said 40 feet.

4078 Q. Now, as to the experiment on September 13th, 1911, with dyes; will you describe that?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. On September 13th, I took a small launch in the morning in company with Doctor Parsons, then in the employ of the Metropolitan Sewerage Commission. We sailed down to the Deer Island outlet, then across to Nutt Island. The day was overcast, although it did not rain, and there was a high wind. On this day I did not add dye to the sewage, but observed the sewage matter coming to the surface in the vicinity of the outlet from Nutt Island. There was a marked and easily distinguishable sewage field and the usual sleek field in the vicinity. I distinguished the sewage field by the color, the dirty appearance of the water, and by the paper and fecal matter, fruit skins, etc., which I could observe in the water.

Q. Will you describe how the sewage came to the surface, as you noticed it?

Mr. Riker: The same objection?

The Commissioner: Note the objection.

A. The sewage came to the surface in the form of a spring, in a pool of water, that is, you could distinguish the movement of the water, the current, the upward current, as it came to the surface and was then spread out laterally in the bay.

Q. Was it higher, the sewage surface, than the surrounding water immediately over the outlet?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. It was slightly high, yes sir.

Q. As to the experiments of May 29th, 1913, will you describe them, Mr. Eddy?

Mr. Riker: The same objection.

4079 The Commissioner: Note the objection.

A. On May 29th, low water, by the Government record occurred at 12:28. At 11:37 I visited the Nutt Island screening station and made preparations for the application of two portions of eosine blue dye. The first portion was of two pounds weight and the second portion a quarter of a pound weight. The two pound package was dissolved into the barrel of water and turned into the sewer at 12:15. The quarter pound package was dissolved in the same quantity of water and poured into the sewer at 12:30. At 12:34½ I observed the two pound dose of dye at the outlet, just 19½ minutes after it had been applied in the screen chamber. At 12:51½, or 21½ minutes after the quarter pound of dye had been applied in the screen house, I observed the colored water in the outlet resulting from that application of dye. On this occasion I visited the outlet a company with W. L. Butcher of my office force and Mr. Grant accompanied us as far as the Nutt Island screen house. We went to the outlet in an open motor boat about 25 feet in length. The wind was quite fresh so that we had shipped considerable water getting to the outlet, but after we got to the outlet, the sleek formed by the grease from the sewage covered a large field, and stilled the water so that we had no difficulty in cruising about within the sewage field. On this day the sewage field could be easily distinguished from the screening station a distance of about 1½ miles from the outlet. This was doubtless due in part at least to the storm water, there having been more or less rain the night before, which gave to the sewage a brown and dirty appearance. The sewage appeared to extend northerly to the shore of Peddock's Island, a distance of about a half mile, and in width at the point nearest the island where I sailed through it, I should say it was at least 1,200 feet. It was a very dirty field containing large quantities of paper, fecal matter and matches, strips of grease, which could be easily distinguished as of sewage origin. The dye in both experi-

2769

ments could very easily be distinguished by its pink color.
4080 It was doubtless more easily distinguished because of the rough water and where the waves broke on the windward side of the sewage field, the pink spray was very easily distinguished. I think the dye could be more easily seen under those conditions than in quiet water.

Q. How deep was the point of discharge during these experiments of May 29th, 1913?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. About 30 feet below the surface.

Q. Now, as to the experiments on May 31, 1913; will you please describe them?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. On this day I was present although the experiments were made by Professor Sedgwick. I was present in the boat which was this same motor boat that I used on the 29th. I visited the Nutt Island screen house, and saw the preparations made for admitting the dye, and my assistant Mr. Weber was left in charge of that work with instructions as to when the dye should be introduced. I was present at the outfall, and saw the dye, and saw the condition of the sewage field and sewage sleek.

Q. How deep is the point of the outlet for the sewage that is discharged from the Treatment Works at Providence, Rhode Island?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. About 25 feet.

Q. Did you make any observations of that sewage discharged from the Treatment works, at Providence, Rhode Island?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I have.

4081 Q. Will you state when and describe what your observations consisted in?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I visited this outlet in the spring of the year of I think 1912, took a rowboat in company with Mr. Julius W. Bugby, who is in charge of the Providence sewage treatment plant, and rowed out through and around the sewage field over the outlet from the sewage treatment works. At that time the quantity of sewage treated was about 20 million gallons per day. The treatment consisted of screening and sedimentation in very large settling basins, together with the application to the sewage of bleaching powder. At the sewage outlet the sewage field could easily be distinguished, the sewage could be

seen as it came to the surface and spread out over the water in Providence River.

Q. How would the treatment that you have just described compare with the treatment proposed by the Passaic Valley Sewerage Commission for the sewage contemplated to be discharged at Robbins Reef?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I think it would be just as efficient.

Q. How deep was the point of discharge, Mr. Eddy?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. About 25 feet.

Q. Was there any difficulty in detecting the sewage field and the sewage as it came to the surface?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. There was not.

Q. Mr. Eddy, directing your attention again to the testimony given by Mr. George A. Johnson at the pages which have been previously referred to, and handing you Complainants' exhibit No. 205, I ask you if you find in that exhibit any reasons for the matters testified to by Mr. Johnson, and for the opinions you have expressed in relation to the disposal of that sewage after its discharge?

Mr. Riker: The question is objected to on the ground that it is not rebuttal of any evidence offered on behalf of the defence, the proper rebuttal requiring the direction of the witness to some specific testimony on behalf of the defence.

The Commissioner: Note the objection of Counsel for the defendants.

A. With reference to the first part of the question, some of the testimony of Mr. Johnson stated that the coloring matter introduced was carried to the surface, and I think that there are reasons due to the configuration of the channel which would tend to carry that dye to the surface of the water. The channel is not as deep in the vicinity of the outlet as it is down stream or up stream from that point, so that there would be a tendency for the incoming current to be carried toward the surface, and a similar tendency for the outgoing current to be carried to the surface. This tendency will cause the sewage to be carried to the surface, and very likely that condition existed at the time of those experiments. Part of his experiments were not successful in his being able to observe the dye, in other words the dye was not observed. I think that this same condition may account for that, in that the current produced was carried so far from the point of application that he did not observe the dye; in other words did not look at the right place for it, which is a thing

which is very easy to occur under such conditions. With respect to the latter part of the question, referring to my own opinion, I think that the configuration of the channel is such that the sewage will come to the surface and that it will be carried along in a body when it forms a sewage field. The channel at the Narrows is very

4083 narrow: It widens out to perhaps twice its width at the Robbins Reef and holds out something like this width almost all the way up to the Battery. So that, a large sewage field, formed in the vicinity of Robbins Reef light would be likely to be carried as in a river or stream, and would not have the tendency to spread out that it would in a very large bay of water subject to greater wind action.

Q. From your studies of the testimony given in relation to dye experiments performed by Mr. Johnson, and from your own observations of the dye experiments performed by you in Boston Harbor, and from your observations of the sewage discharge from the submerged outlet, 30 and 40 feet below the surface, in your opinion will the sewage contemplated to be discharged by the Passaic Valley sewer project rise to the surface from the submerged multiple outlets at or near Robbins Reef?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I believe it will.

Q. And in your opinion, will it or will it not occasion a nuisance to both the nostrils and the eye?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I think it will.

Mr. O'Sullivan: He is your witness.

Cross-examination by Mr. Riker:

Q. What is your business, Mr. Eddy?

A. Consulting Engineer.

Q. Designing sewage disposal plants, part of it?

A. Yes sir.

Q. Your field in the Passaic Valley is a valuable field if you can get in there, for the separate municipalities, is it not?

A. I have never considered it such.

Q. Aren't you concerned in the designing of the plant for Montclair?

A. No sir.

Q. You have been asked to consult on it, have you not?

4084 A. I have made a report on a number of projects in that vicinity.

Q. You are, of course, here, under the employ of the Complainants?

A. I am.

Q. And being paid as an expert for your testimony?

A. Yes sir.

Q. What do you understand is the proposed discharge from the Passaic Valley sewer?

A. The sewage from a population of about 1 $\frac{3}{4}$ millions of people or a little under that.

Q. In a crude state?

A. Yes and no, both. That is, crude in the sense that it is not modified by chemical or bacteriological treatment, in the sense usually applied.

Q. Is that as you understand crude sewage?

A. It is crude sewage, although crude or raw sewage is the term sometimes actually applied to the sewage actually flowing in the sewers.

Q. We won't bandy words; untreated sewage, you understand it to be untreated sewage?

A. In one sense. It is settled sewage.

Q. Can it be treated in any sense if it is treated at all?

A. Yes.

Q. What sense?

A. In the sense it is not treated with chemicals or bacteriological processes.

Q. Then you mean to say that if it is not treated by these processes it is not treated at all?

A. The word is used loosely, both ways, to include sewage which is treated by chemicals or sewage which is treated by sedimentation, by that process.

Q. Well, when I asked you whether you understand the sewage to be discharged is untreated, what is your answer?

A. It may be or may not. It is treated by sedimentation processes, if you call that treatment, and is not treated by chemicals or bacteriological processes.

Q. I am asking you what you call it, not what I call it; do you call it treated, or do you call it untreated?

A. I should say it was treated by a process of sedimentation.

Q. Now, were you present at the time Mr. Johnson made his dye experiments?

4085 A. I was not.

Q. Have you ever made dye experiments in New York Harbor?

A. I have not.

Q. Do you mean to say that you believe that Mr. Johnson did not observe things that existed?

A. I think that may be the case.

Q. I ask you whether you think it is so?

A. I think it is so.

Q. Or that he is not testifying to what he did really observe?

A. I don't think that.

Q. Are you taking into consideration when you answer the question as to the proposed discharge of the Passaic Valley sewers the stipulation with the United States Government?

A. A part of it at least.

Q. Not the whole of it; are you not taking the whole of it; are you not taking the whole of it into consideration?

A. I am not taking into consideration the statement that refers to its not creating a nuisance.

Q. You mean then by that that is the discharge that is proposed by the Passaic Valley Sewerage Commissioners?

A. I understand that is the discharge which was covered by the agreement.

Q. I ask you whether you wish to be understood as testifying that you do not believe that that is the discharge that is proposed by the Passaic Valley Sewerage Commissioners?

A. Why, I think it is the discharge that is proposed by the Passaic Valley Sewerage Commissioners, but I do not think it can be produced by the works covered by this contract specified.

Q. You were asked on your direct examination at this time whether or not the proposed discharge would result in certain ways which were described to you; you remember that, don't you?

A. No, I do not.

Q. You don't remember that?

A. I do not remember that.

Q. Do you remember being asked as to the proposed discharge?

A. I was asked some questions as to the proposed discharge; yes, sir.

Q. And as to its effects in New York Harbor?

A. Yes sir.

Q. Malodorous conditions?

A. I think so.

Q. Unsightly conditions to be produced by the proposed discharge?

A. I don't remember that was covered; I think very likely it was.

4086 Q. Well, now do you mean to say that the discharge as proposed in this stipulation will produce those results in New York Harbor?

A. I don't know what results you mean.

Q. Malodorous results, and results of unpleasant, obnoxious appearances to the eye?

A. I think sewage treated as specified in the contract will produce those conditions.

Q. Will you answer the question directly, Mr. Eddy, and say whether or not in your opinion the effluent discharged as proposed in this stipulation will produce the results which you have testified to?

A. Taking the whole stipulation, I should say not.

Q. Don't you understand that the proposed discharge is that which is guaranteed in this stipulation?

Mr. O'Sullivan: The question is objected to as misleading; the sewage effluent is not guaranteed; it is the results that will follow from the discharge of that sewage effluent.

The Commissioner: Note the objection of Counsel for the Complainants.

A. I should answer that question yes.

Q. And do you mean to say that that proposed discharge will produce malodorous conditions and conditions of nuisance as you have testified to?

A. Not if the discharge coincides with the contract, I don't think it will.

Q. Well, do you understand that the contract indicates the proposed discharge?

A. I think it does.

Q. Then, all you mean to say, Mr. Eddy, is that the treatment that is specifically described in this stipulation, in your opinion, will not produce the guaranteed results?

A. That is what I mean, yes sir.

Q. That is all you mean?

A. Yes sir.

Q. And that is what you testified on your direct examination?

A. I may have; I think I did.

Q. And that is a matter of opinion, is it not?

A. It is.

4087 Q. In that you differ from Mr. Johnson?

A. I do, I think. I think I have read his opinion on that.

Q. And you differ from other witnesses whose testimony you have read, for the defence?

A. I think so—yes, for the defence.

Redirect examination by Mr. O'Sullivan:

Q. Mr. Eddy, directing your attention to Complainants' Exhibit No. 135, I ask you as a sanitary engineer if it is possible to produce that effluent with the plant and appliances described in that stipulation?

A. That question appears to apply simply to the effluent and not to the conditions about the outlet. I cannot answer that exactly in that form.

Q. Well, in what condition will the sewage reach the disposal works on the Newark Meadows?

A. I think the suspended matter will be largely disintegrated and broken up into small particles. The sewage during warm weather will be in a putrid condition; there will not be dissolved oxygen in it, it will be offensive, and what may be described as a septic condition.

Q. Treating the sewage that you have now described by passing it through a screen with a 4/10-inch mesh and sedimenting for not more than an hour and a half or giving a detention period not greater than an hour and a half, can you by that mode of treatment produce an effluent that will be in accordance with the stipulated results in Complainants' Exhibit No. 135?

A. I don't think you can.

Mr. O'Sullivan: That is all.

Mr. Riker: No more questions.

Adjourned to June 5th, 1913, at 10:30 A. M.

4088 Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COM-
MISSIONERS, Defendants.

NEW YORK CITY, June 5th, 1913—10:30 a. m.

Before James D. Maher, Esq., Commissioner.

Appearances:

William J. O'Sullivan, Esq., Special Counsel for the People of the State of New York, Complainants.

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

WILLIAM P. MASON, a witness in behalf of the Complainants, recalled in rebuttal, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. Professor Mason, what is your full name?

A. William P. Mason.

Q. Have you testified previously in this suit?

A. I have.

Q. Was your attention specifically directed to pages 3963 to 4121 and pages 4148 to 4162 of the testimony in this case?

A. Yes, sir.

Q. Did you recently undertake any oxygen determinations in relation to the matters that your attention has now been directed to, to verify or to refute those matters?

4089 Mr. Riker: The question is objected to as not being rebuttal.

The Commissioner: Note the objection of Counsel for Defendants.

A. I did.

Q. When?

A. On April 21st and subsequent dates with Professor Phelps, accompanied by Dr. Schwartz and an assistant, I took samples from a point near Robbins Reef, at depths of 5, 10, and 20 feet, the times being, on the 21st of that month, as follows: 11.20, 12.40, 2.30, and 3.55 at Robbins Reef and at Kill van Kull, 1.30 and 3.22. On the 22nd, the times were 10.45, 12.20, 1.40, 3.00 and 4.00 at Robbins Reef; and on the same day, 10.10, 11.30, 1.00, 2.30 and 3.30 at Kill van Kull. Samples were taken then on the 23rd at Robbins Reef; 9.55, 11.00, 11.55, 1.00, 2.10 and 3.18; and at Kill van Kull

10.30, 11.30, 12.30, 1.45 and 2.50. On the 24th they were: 10.25, 11.30, 12.55, 2.03 and 3.12; and at Kill van Kull, 11.00, 12.17, 1.35 and 3.37. On the 25th at Robbins Reef, 9.32, 10.30, 11.25, 12.25, 1.20, 2.30, 3.20; at the Kill van Kull, 10.00, 10.55, 12.00, 12.55, 1.50, and 2.55. On the 26th, at Robbins Reef, 9.30, 10.30, 11.30, 12.23, 1.15 and 2.10; at the Kill van Kull, 10.00, 11.00, 11.55, 12.50 and 1.45.

Q. In taking the samples, did you take the temperature of the water?

A. The temperature was taken at the same time.

Q. And the condition of the tide, was that noted?

A. The condition of the tide as well as the condition of the weather. These samples were analyzed at once for dissolved oxygen, similar samples being taken at the time stated from the Kill van Kull and from Robbins Reef. In all, 224 samples of water were so analyzed.

Q. What were the average results of dissolved oxygen present in the samples during the ebb tide?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The averages for the whole week, giving centimeters 4090 of oxygen per liter, ebb tide, Robbins Reef; 5 feet depth, 5.97; 10 feet depth, 5.94; 20 feet depth 6.01. The Kill van Kull, same data: 5 feet depth, 6.05; 10 feet depth 5.94; 20 feet depth, 6.02.

Q. What do these results show as indicating the difference between the quality of the water of the Kill van Kull and the quality of the water near Robbins Reef Light?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. They indicate the water of the Kill van Kull to be better than the water at Robbins Reef.

Q. In your previous testimony in this case, did you indicate any such difference in the quality of these waters from these two locations?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Q. Yes, basing my opinion at that time upon data secured by the Metropolitan Sewerage Commission.

Q. Did you find in your preliminary investigations and determinations that the dissolved oxygen results from these investigations made by you supports the opinion which you expressed when using the data of the Metropolitan Sewerage Commission?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes. The water of the Kill van Kull was still shown to be better than that of Robbins Reef, but the margin of difference be-

tween the two was smaller, both bodies of water having lost oxygen contents since the time when the Metropolitan Sewerage Commission took the samples.

Q. What, in your opinion, is that smaller margin of difference now due to?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

4091 A. That smaller margin of difference is due to the fact that the water of Newark Bay and consequently the outlet thereof is not as good as it was a few years ago, on account of the large quantity of material having been added to it, in the way of sewage material. The same would apply to any difference noted in the water of New York Bay, between what it is now and what it was at that time.

Q. Have you got the percentages of saturation that were found to exist in the Kill van Kull for 1911 and for Robbins Reef Light region for 1911?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The percentage of saturation for the Kill van Kull was 79 per cent. dissolved oxygen and for the New York Bay 67 per cent. oxygen, both from the Metropolitan Sewerage Commission's data.

Q. Now, applying that ratio to the present average of figures, what do you find in relation to these two bodies of water?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Applying that ratio for the ebb tides, the ratio—using the figures of the Metropolitan Sewerage Commission—should stand 5.97 to 7.04. That is the amount of dissolved oxygen in the Kill van Kull should be 7.04, instead of the 6.06 which it is now, it having got now a smaller quantity of oxygen in solution than it had at that time.

Q. Professor Mason, if such sewage were to receive an inflow of septic sewage, would such addition cause the combined sewage volume to become septic faster or slower than if fresh sewage were allowed to become septic itself by the lapse of time without such inflow?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. It would become septic faster for the reason that it would be seeded by an already active growth of decomposition organisms.

4092 Q. What portion of sewage will more readily putrefy, that in which the particles are finely divided and do not quickly subside, or that in which the coarser suspended particles exist?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The more finely divided sewage material will putrefy with greater readiness, and that finely divided material is more common in septic sewage than in fresh.

Q. What difference is there in the oxidizing process when applied to fresh and when applied to septic sewage, in which you have stated the finely divided suspended particles are most plentiful?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. In fresh sewage the process is a biologic one and consequently slower, whereas in septic sewage, the oxidizing process is more largely chemical and direct, and consequently faster.

Q. Which of the two modes of oxidation exhaust the oxygen contents of a body of water most rapidly?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The second one, that is the septic sewage, would more rapidly exhaust the oxidizing reserve of the water into which it flowed, as compared with the same quantity of fresh sewage.

Q. Does septic sewage give off malodorous gases?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes.

Mr. O'Sullivan: He is your witness, Mr. Riker.

4093 Cross-examination by Mr. Riker:

Q. Your attention has been directed to certain testimony contained in the transcripts which you have seen; what part of that testimony do you think is affected in any way by the observations that you made in the Kill van Kull and at Robbins Reef?

A. My attention was directed in reading that testimony over, to a statement made that sewage contained a considerable amount of oxygen and consequently had a refreshing influence upon the water into which it was emptied.

Q. You understand that that is this statement as Mr. Johnson made it?

A. Mr. Johnson made that statement as I understand it.

Q. Without limitation or description or definition of any kind?

A. Yes, there was some limitation. He at least led me to believe that he was dumping that sewage into water which was already pretty heavily polluted.

Q. More or less than the sewage that was being dumped?

A. I beg pardon?

Q. Was it more or less deteriorated by pollution than the sewage discharge itself, as you understand his statement?

A. I do not remember the relation between the two bodies, but I think his intention was to convey the impression that the liquid into which he was dumping it was more polluted than the sewage he was dumping in.

Q. And you disagree with that if that is the testimony?

A. No, I don't disagree with that particularly.

Q. Well, what other part of Mr. Johnson's testimony do you think is affected in any way by the experiments which were conducted and the determinations of oxygen at the Kill van Kull and at Robbins Reef to which you testified?

A. The point which I note now is a statement of his that the large particles of sewage will putrefy more readily than the smaller ones. I cannot agree with that.

Q. No; what I asked you was what relation do the experiments that were had on oxygen determinations in the Kill van Kull 4094 and at Robbins Reef, in your opinion, bear to any of his testimony?

A. I do not think it bears any relation to that, do you; except that he referred to the dissolved oxygen in the sewage and to the quantity of dissolved oxygen in the liquid into which the sewage was dumped.

Q. I know; but I am directing your attention now particularly to your determinations of oxygen at these two points. I want to find out what testimony that was given by Mr. Johnson you think that has any relation to?

A. Well, merely this: his statements were made with reference to the effect that sewage would have upon a water into which such sewage stream was allowed to flow.

Q. You don't understand there is any such sewage stream allowed to flow into the Kill van Kull or Robbins Reef now, do you?

A. No, not straight sewage; that is so.

Q. Well, have you any doubt that the waters of the Kill van Kull are actually polluted with sewage?

A. Oh, surely.

Q. What?

A. Surely they are.

Q. And have you any question that that pollution to a large extent comes from the Passaic River?

A. No doubt of it.

Q. And that the more greatly deteriorated condition of the water at Robbins Reef is contributed to by the conditions of the waters of the Kill van Kull; you have no doubt of that, have you?

A. Well, the Kill van Kull water is better than that at Robbins Reef.

Q. I understand that, but have you any doubt that the conditions of the Kill van Kull water are nevertheless contributed to by the deterioration of the conditions of the Robbins Reef water—that the conditions of the Robbins Reef water was contributed to by the condition of the Kill van Kull water?

A. No, I cannot admit that, because it is better.

Q. Do you mean to say that if the Kill van Kull water was not polluted at all, that it would not have a beneficial effect upon the conditions of Robbins Reef?

A. Oh, surely it would.

4095 Q. Well, when you deteriorate the waters near the Kill van Kull, wouldn't that have an effect on the waters at Robbins Reef?

A. It would lessen the quantity of improvement.

Q. Do you think, therefore, the conditions of the Kill van Kull water contributes to the conditions of the water at Robbins Reef?

A. In that it lessens the amount the amount of improvement; it surely does.

Q. So that if you remove out of the waters of the Kill van Kull, the pollution due to the Passaic River, you would naturally improve the conditions at Robbins Reef?

A. Whatever you do in order to improve the Kill van Kull would surely improve conditions at Robbins Reef.

Q. I am asking you a specific question; if you remove the sewage of the Passaic Valley from the Passaic River and therefore from the Kill van Kull, don't you think the waters at Robbins Reef would be improved?

A. You haven't stated what you do to improve it.

Q. You are not going to put it into Robbins Reef water; you are simply going to remove it?

A. That is true.

Q. Well, now, Professor Mason, with respect to the abstraction of the oxygen in water, do you think that that abstraction is more nearly produced or caused by deposits of organic matter on the floor of the body of water, or when it is held in suspension and removed from time to time by the ebbs of the tides?

A. The quantities being the same? If I understand you, given a certain amount of septic sewage, allowed to deposit, or allowed to stay in suspension, under which circumstances would that give an amount of pollution to reduce the dissolved oxygen?

Q. Recognizing the fact that the matter in suspension is being carried out by the ebb tide and dispersed in the course of six tides. I will add that to the question.

A. There is no question whatever but that the same amount of material in suspension would be a greater strain upon the oxygen and use it up faster than that same quantity in deposits on the bottom or the floor of the harbor, because it is brought into contact with the oxygen and is more putrescible.

4096 Q. Well, taking the conditions in the harbor of New York for example, do you understand that the deterioration in oxygen is more largely due to the suspended matter or the matter that has been deposited in the shape of muds on the floor of the bay or harbor?

A. Without further information I should say that it was used up more by the septic material in suspension.

Q. If the witnesses for the Complainants have testified to the contrary, you don't agree with them?

A. Not unless they give me more information than I have from your questions.

Q. Well, what character of sewage material is more likely to be deposited on the floor of New York Bay, the fine matter or the larger matter?

A. Oh, the larger matter.

Q. Isn't that what you understand Mr. Johnson testified to?

A. I don't recall that; that is not to what I referred a moment ago when I spoke of the testimony.

Q. Well, if he is testifying that the larger matter being more subject to deposition on the floor of the harbor or the bay was more provocative of the condition of lessening oxygen than the finer matter which was held in suspension, and would be carried out on the tides, do you disagree with him?

A. I don't quite understand that.

Q. What I mean is, whether you think the heavy matter which is deposited on the floor of the harbor will reduce the oxygen more than the finer matter which is in suspension and which is carried out on the succeeding tides?

A. If the finer septic matter is carried through the waters, it would be; that it would come into contact with the oxygen more quickly and that would reduce the oxygen more readily.

Q. You disagree with him on that basis, do you?

A. If I understand the question, I do; yes.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Professor Mason have you studied the oxygen tabulations and determinations made for the year 1909 and the
4097 year 1911 by the Metropolitan Sewerage Commission?

A. I am not sure of the date. I have studied practically all they have got. I cannot swear to the date.

Q. Do you recall whether or not, Professor Mason, you studied two sets of tabulated dissolved oxygen determinations for any two years prior to your first testifying in this suit?

A. Yes, I studied all the oxygen then.

Q. Do you recall one set was for the year 1909 and the other set for the year 1911?

A. My impression is those are the dates.

Q. From your study of the tabulations for the year 1909 and the year 1911, and the determinations made by yourself in the same regions of Robbins Reef and the Kill van Kull, do you find a steady decline or not, in the oxygen contents?

Mr. Riker: I object to that question on the ground that it is not redirect examination.

The Commissioner: Note the objection of Counsel for the Defendants.

A. I cannot answer that without reference to the figures and I do not carry them in my head. That is, at the Kill van Kull, there has been a decline. I cannot give you the figures.

Q. I was asking you for the fact, Professor Mason, not the figures?

A. I can answer it as a fact for the Kill van Kull. I would have to refer to the record for the rest of the answer.

Q. How about Robbins Reef?

A. That is the part I will have to have the figures for before I answer.

Q. Are fine suspended septic particles oscillating on several sides in a body of water capable of exhausting that body of water of its oxygen contents more rapidly than heavier particles that have been sedimented and deposited on the bottom of that body of water?

A. Yes.

Mr. O'Sullivan: That is all.

Mr. Riker: That is all. No more questions.

4098 CHARLES E. NORTH, a witness in behalf of the Complainants, recalled in rebuttal, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Doctor?

A. Charles E. North.

Q. You testified a couple of days ago in this suit?

A. Yes, sir.

Q. On the subject of bacteriology?

A. Yes, sir.

Q. Have you made any specialty within your profession, and if so, state what it is, Doctor, and what your experiences were in that specialty?

A. I have made a specialty of consulting sanitary work and public health work. I am a practicing sanitarian.

Q. Where have you made any investigations, what experience have you had?

A. I was trained in bacteriology in Wesleyan University at Middletown, Connecticut, where I took the degree of A. B. and also specialized in chemistry under Atwater at the same institution. I was trained in medicine and took the degree of M. D. at Columbia University, after which I took a Post Graduate course at the same institution in bacteriology. I was director of the Department of Bacteriology in the Lederle Laboratories for 3 years, during which period I had charge of all the important sanitary investigations which were conducted by those laboratories. These included chemical and bacteriological examinations in the laboratories and also extensive inspections connected with epidemics and sanitary work outside of the laboratories. For two years I was employed by Jersey City as bacteriologist in the litigation which that City conducted against the Jersey City Water Supply Company, and during that period had charge of all of the bacteriological work, connected with the investigations of the Jersey City Water Supply. For five years, I have been practising privately as a consulting sanitarian and during that period have maintained laboratories for chemical and bacteriological work of my own, and have had charge of the investigation of a variety of sanitary problems including several large epidemics of disease. These epidemics have included scarlet fever, diptheria, typhoid fever, septic sore throat and some other minor outbreaks. In this connection it has been necessary for me to pay particular attention to vital statistics and the work carried out by public health officials, in large and small cities. As a conse-

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quence, I have made a special study of the broader aspects of public health problems and have published a number of papers on public health questions. I am frequently consulted by public health authorities in large and small cities on special questions of public health.

Q. Dr. North, has your attention been specifically directed and have you read the testimony given on pages 4107 to 4112, both inclusive, given by Mr. George A. Johnson, on the production of indol, skatol, phenol, cadaverin, mercaptan, phosphine, cresenol and the other putrefactive products testified to on the pages named?

A. I have, yes, sir.

Q. I direct your attention specifically to the last question on page 4111 of the record: "Q. Do you regard indol, skatol, cadaverin, mercaptan and these other compounds that we were considering as more or less repulsive than sulphuretted hydrogen? A. I expect it is all a matter of taste or smell. Q. In your particular case, which do you regard as the most repulsive? A. Well, I do not particularly like any of them, but probably indol is the most offensive" etc. Is indol the most offensive of the gases and putrefactive products that I have mentioned previously in the question?

A. No, sir, it is not.

Q. Which do you consider the most repulsive of these odor nuisances?

Mr. Riker: The question is objected to on the ground that it is not rebuttal, the testimony of the defendants' witness, being that so far as he was concerned he recognized one of these as more offensive than the other, and what this witness may recognize is not rebuttal of what the testimony of the defense was.

The Commissioner: Note the objection of Counsel for the Defendants.

A. I consider that hydrogen sulphide and mercaptan are far more offensive than indol and I believe I am supported in that by other authorities.

Q. I direct your attention to a question and answer appearing on page 4112 of the record: "Q. Is there any provision made in the sewage disposal works of the Passaic Valley Sewerage Commissioners for the removal of these substances from the sewage to be treated at or near the Newark Meadows? A. We gave some consideration to the feasibility of removing these odors should they be present, from the sewage before it is discharged into the Bay. We were unable to find any feasible method for so doing, that would come within reasonable cost. As a matter of fact, so far as I know, this is not done in connection with any sewage disposal project in the world." Can sewage be so treated as to remove these odors?

A. It can.

Q. Mr. George A. Johnson has testified that the sewage effluents proposed to be discharged by the Passaic Valley Sewerage Commissioners will occasion no injury to the public health and will create no private or public nuisance in accordance with the stipulation in

Complainants' Exhibit No. 135. In your opinion will the sewage effluent proposed to be discharged by the Passaic Valley Sewerage Commissioners occasion public or private nuisance, and will such nuisance be injurious to the public health?

A. In my opinion the discharge of the sewage from the Passaic Valley sewer will occasion a public and private nuisance and will cause odors which will be injurious to the public health.

Q. What injury to health do odor nuisances occasion, Dr. North?

Mr. Riker: Objected to as not being rebuttal of any evidence of the defense.

The Commissioner: Note the objection of Counsel for the defendants.

A. The effect of odors upon health depends upon two things: first, the susceptibility of the persons affected; and, second, the character of the odors themselves.

Q. Taking the character of the odors themselves, how do these putrefactive odors affect health injuriously?

4101 Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. The offensiveness of an odor depends upon its effect on the nerves of smell and upon its intensity and its character and the duration of time over which it reaches individuals.

Q. Is that injury to health from nuisance odors a recognized one by Boards of Health?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. It is universally recognized by sanitary authorities that odors are nuisances and legislation has been directed against odors by all constituted health authorities. I might illustrate the character of these prohibitions, by citing from a few sections of the Sanitary Code of New York City. Section 10 of the Sanitary Code of New York states: "That it is hereby declared to be the duty of every owner * * * lessee * * * of any place * * * to keep place and preserve the same and the sewage, drainage and ventilation thereof in such condition and to conduct the same in such manner that it shall not be a nuisance or be dangerous or prejudicial to life or health."

Section 20 states: " * * * no offensive smell or gas from or through any outlet or sewer or through any such privy or water closet shall be allowed * * * to pass into such house or any part thereof."

Section 33 states: "Every water closet * * * must be separately and effectively trapped."

Section 36 states: "Water and soil pipes in every lodging house or dwelling shall be ventilated."

Section 17 states: "No owner * * * shall lease or let or hire out any building * * * which is impregnated or penetrated by any offensive gas or smell or exhalation prejudicial to health."

Section 38 states: "No person * * * shall * * *
 4102 allow any sewage, drainage, factory refuse or any foul or offensive liquid to flow, leak, escape, or be emptied into any river, stream, canal, etc., excepting under low water mark and in such manner and under such conditions that no nuisance can or shall be caused thereby."

Section 88 says: "No person shall permit or have any offensive water or other liquid or substance on his premises * * * no establishment * * * for carrying on any offensive or noisome business shall hereafter be opened * * * in the city of New York. * * * Such establishment now existing shall be * * * so conducted * * * as not to be offensive or prejudicial to health or life."

Section 99 states: "No ground or material filled with offensive matter * * * or that will emit or allow to raise through or from the same any offensive smell or deleterious exhalation shall (adjacent to or within the built up portion of said city) be opened."

These extracts show that odors are recognized as nuisances by the Department of Health.

Mr. Riker: Counsel for the Defendants moves to strike out all this testimony in regard to the Code of Health of New York City, as not being responsive to any questions and not being anticipated on the ground that they are not properly proved, not material and not rebuttal.

The Commissioner: Note the motion of Counsel for the Defendants to strike out.

Q. Are the various sections that you have just alluded to from the New York City Department of Health exceptional, or are they generally recognized by Health Boards throughout the United States?

Mr. Riker: The question is objected to as not rebuttal, as immaterial and improper.

The Commissioner: Note the objection of Counsel for the Defendants.

A. They are generally recognized by sanitary authorities, throughout the United States.

4103 Q. Are they embodied in their sanitary codes as prohibitions?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. They are embodied in their sanitary codes.

Q. Have any great sanitarians investigated the gaseous products of decomposition arising from sewers and their injury to health?

Mr. Riker: The question is objected to on the ground that it is not rebuttal and is immaterial and irrelevant.

The Commissioner: Note the objection of Counsel for the Defendants.

A. Many sanitarians have investigated gaseous products of sewage and their relation to public health. Some of these I have collected.

Kirchner & Lindley in 1905 published a paper before German Society of Public Health, in which they state: "The gaseous products of decomposition arising in sewers and house drains may be harmful indirectly, if not directly, to those exposed to them for a considerable time. They may produce nausea and may lower the general tone of the body, including its resistance against disease." Godfrey, in a book entitled "The Health of the City" published in 1910, said: "It is entirely possible that odors of sewer gas interfering with appetite and digestion might weaken the condition. * * * A research conducted by Dr. Alessi of the University of Rome, indicated that animal life when exposed to the effect of gases produced by decomposition in sewage lost its power of resistance to certain specific germ diseases. * * * Roehling, in book entitled "Sewer Gas and its influence on Health" believes that the action of sewer gas may predispose the individual to attacks of disease.

R. C. McFie in a book entitled "Air & Health" published in 1909, states: "To bad air we attribute much of the anemia, the pallor and the neurasthenia, the general ill health of the slum dweller and factory worker and most persons engaged in sedentary indoor 4104 occupations * * * (Page 133). Any one who compares his power of mental work in a pure and in a carbonic-acid-laden atmosphere, even if the latter be dry and cool, will find in the latter a considerable diminution, showing that at least nerve metabolism is affected. Nature has taken such particular pains to supply the nervous system with particularly pure, well-oxidized blood, that it is probable a very small oxidative difference may have considerable consequences. (Page 134.) It may be contended that the human constitution becomes in time accustomed to vitiated air, and that much of the ill health ascribed to bad air is really due to other circumstances, such as poor feeding and depressing surroundings, but the difference in health between country poor and city poor, and the improvement in health which always follows removal from impure to pure air is sufficient answer to such a contention. * * * An open window may work wonders; and the improvement in appetite, nerve vigor, blood quality and muscular tone which follows open air treatment even in the rich and well fed, shows the paramount importance of fresh air. Can it be doubted when even a whiff of air may revive a fainting patient?" Page 23: "The air of towns, even in clean well ventilated streets has a slightly larger percentage of carbon dioxide than country air. Thus Boussingault and Levy found .0319 per cent. of carbon dioxide in Paris air, and only .0299 per cent. in Andilly, a small village 12 miles away."

Q. What is the composition of normal air?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. The composition of normal air: Oxygen 20.94; Carbon dioxide 0.03; Nitrogen 78.09; Argon 0.94. There are also traces of Helium, Krypton, Neon, Xenon, Hydrogen peroxide, Ammonia, and in addition water vapor in various amounts, nitric acid, nitrus acid, radioactive substances and dust. In an adult man about 500 c. c. of air is

inspired and expired at each breath at the rate of 15 to 16
4105 times a minute. The normal lungs hold a total volume of
about 3,500 c. c. The total of 3,500 c. c. in the chest is made
up as follows.

Tidal air.....	500 c. c.
Supplemental or reserve air.....	1,500 c. c.
Residual	1,500 c. c.

By force it is possible to add another 1,500 c. c. in inspiration,
making a total of 5,000 c. c.

Gaseous changes in air and blood in respiration:

	Oxygen.	Nitrogen.	Carbon dioxide
Inspired air.....	21	78	.03
Expired air.....	16	79	4.3
Blood reaching lungs.....	8 to 12	1.2	46
Blood after exposure to air in lung.	20	1.2	40

Q. Has any experimental work been done to determine the per-
centage of carbon dioxide in city air, and if so, state such facts as you
have in relation thereto and the effect of odors in conjunction there-
with?

Mr. Riker: The question is objected to for the same reason as to
the last question.

The Commissioner: Note the objection of Counsel for the De-
fendants.

A. In the same publication on "Air and Health" above referred to
th statement is made regarding experiment work that Haldane &
Osborn found a percentage of carbon dioxide in tailoring workshops
from .320 to .532 * * * in textile factories from .032 to
.470. * * * Dr. Scott Tebb found .038 in the open streets and
.116 in the tube railway carriages. On the average during complete
rest a man discharges about .6 of a foot of carbon dioxide per hour
and a woman about .4 of a cubic foot * * * Page 123. After
the battle of Austerlitz 300 Austrian soldiers were shut in a small
prison and 260 were killed by the impure air. In the tragedy
4106 known as the Black Hole of Calcutta, January 18th, 1756,

146 adults were shut in a room 18 feet square, with only two
small windows to ventilate it. They were shut in at 8 P. M., within
an hour some were dead; when the door was opened at 6.20 the next
morning, only 23 were left alive * * * Page 129: Air con-
taining merely the carbon dioxide and moisture usually contained
in vitiated air, will not produce the effect of vitiated air, and vitiated
air must therefore contain an additional constituent. This additional
constituent, though undetected by chemists, is probably detected by
the nose, for it is well known that air is oppressive and harmful not
so much in proportion to the amount of carbon dioxide and moisture
it contains, as in proportion to its smelliness. The relation between
organic effluvia and the healthful performance of physiological

functions is so close that a bad smell may cause nausea or faintness. The very fact that the nose is so sensitive to such odors would seem to suggest their harmfulness * * * Parkes and Kenwood suggest that the action of odoriferous volatile substances on the olfactory nerves may ultimately induce through the central nervous system alterations in respiration, circulation and nutrition, which are inconsistent with the maintenance of good health * * * Always during City fogs sickness increases and the death rate rises. Increase in the City of London for one week ending January 2nd, 1892, after a fortnight of dense fog the deaths exceeded by 1,484 the average number. Increase took place in the following diseases: Measles 114 per cent; Whooping Cough 173; Phthisis 42; Old age 36; Apoplexy 58; Circulatory diseases 106; Bronchitis 170; Pneumonia 111; other respiratory diseases 135 * * * No doubt much chronic ill health anemia, neurasthenia, dyspepsia, etc., may be produced by such polluted air * * * We have talked so far of the ordinary smoke and ordinary smoke fog * * * The Public Health Act of 1891 enacts "For the purposes of this Act, any fire place or furnace which does not so far as practicable consume the smoke arising from the combustible used therein * * * or * * * which emits black smoke in such quantities as to be a nuisance, shall 4107 be deemed a nuisance and liable to be dealt with summarily in the manner provided by this Act."

The Act of 1863 enacted that smoke must not contain more than 5 per cent. of hydrochloric acid * * * Law, therefore, has done something to prevent the pollution of the atmosphere.

Q. Dr. North, do the odors themselves emanating from putrefactive sewage affect health?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for the Defendants.

A. They do, and I find that my observations are fully supported by those of many eminent sanitarians, such as Harrington in "Practical Hygiene" states: "The chief importance of sewer gas lies not in its power to produce disease but in its capacity for being a vehicle for odors which make the air disagreeable, but not necessarily dangerous to health, except that appetite and digestion, and hence general nutrition may be interfered with" * * * It is asserted commonly that the inhalation of small amounts of this air will produce headache, anemia, loss of appetite. Page 244: Disagreeable smells do not act directly as the cause of specific disease, but appear to have an influence on the appetite and hence on the general well being of persons not accustomed to them. * * * It seems probable also that there is much to learn concerning the real effects of disagreeable smells and that they may be more extensive than we now commonly believe." Egbert in "Hygiene and Sanitation" states: Either soil-air or sewer-gas may possibly at times carry the germs of infectious diseases. Their influence, however, is usually insidious, owing to dilution with the house-air; and the most common symptoms will probably be pallor, languor, frequent headache

and loss of appetite. Notter & Firth, page 159: "There is undoubtedly a poisonous agency at work when sewer gas is inhaled, which though it may not directly act, yet so prepares the soil that the system is unable to resist the invading organism when it comes."

Valery Havard, "Manual on Military Hygiene" 1909, page 4108 331: "Plumbing fixtures properly trapped completely exclude sewer air, so that if foul smells are noticed they are almost always due to decomposition of excreta or other organic matter within the fixtures, pipes or traps. Such smells may produce headache and affect the appetite and digestion."

Whitelegge and Newman "Hygiene and Public Health," 1910, page 258: "Air contaminated by sewage emanations may, however, be a cause of diarrhœa and other gastro-intestinal disturbances, and of certain forms of sore throat. Anemia, depression and general ill health may result from protracted exposure to such an atmosphere."

Bergey, in "Principle of Hygiene," 1904, page 51, states: "When a portion of a sewer or the drainage-pipes of a house become obstructed so that there is no longer a free circulation of air in the obstructed portion, then there is an accumulation of putrefactive gases, such as carbon dioxide, hydrogen sulphid, marsh gas, etc., and these gases are highly injurious when inhaled in considerable quantities, or in smaller amounts for a considerable time." Page 56, "The odor of animal organic matter when present in the air, even in small amounts, is very offensive and readily detectable." Page 60: "Hydrogen Sulphid. This gas acts as a narcotic poison; one volume per 1,000 volumes of air being fatal to dogs. The chronic effects produced by inhalation of small quantities are depression, digestive disturbances, and anemia, with narcotic or convulsive symptoms in more acute and severe cases." Page 61:

"Slighter vitiation of the air when continued for some time cause anemia, weakness and general depression of the vital forces, nutrition being gravely interfered with. * * * It is a matter of fact that headache, malaise, want of appetite and energy, are caused by habitual breathing of impure air."

William H. Howell, "A Text-Book of Physiology," 1907, page 284: "Even in ourselves the actual amount of olfactory material which suffices to give a distinct sensation is often beyond our means of determination, except by the aid of calculation. It is recognized in chemical work for instance, that traces of known substances too small to give the ordinary chemical actions may be detected easily by the sense of smell. By taking known amounts of odoriferous substances and diluting them to known extents, it is possible to express in weights the minimal amount of each substance that can cause a sensation. By this method such figures as the following are obtained: Camphor is perceived in a dilution of 1 part to 400,000; musk 1 part to 8,000,000; vanillin 1 part to 10,000; while according to the experiments of Fischer and Pen-

zoldt, mercaptan may be detected in a dilution of $\frac{1}{23,000,000}$ of a

$\frac{1}{460,000,000}$ of a mil-igram in 50 c. c. of air."

Oster, "The Principles and Practice of Medicine," 1899 Page 343: "Cases which follow exposure to foul odors or sewer gas. That a febrile paroxysm may follow a prolonged exposure to noxious odors has long been recognized. The cases which have been described under this heading are of two kinds: an acute severe form with nausea, vomiting, colic and fever, followed perhaps by a condition of collapse or coma; secondly, a form of low fever, with or without chills. A good deal of doubt still exists in the minds of the profession about these cases of so-called sewer gas poisoning. * * * There are instances in which persons have been taken ill with vomiting and slight fever after exposure to the odor of a very offensive post-mortem. The idea is firmly implanted in the minds of the laity that very powerful odors from decomposing matters may produce sickness. Page 451: In so many instances defective drainage has been found associated with outbreaks of follicular tonsillitis that sewer gas is regarded as a common exciting cause."

C. A. Herter, M. D., "The common Bacterial Infections of the Digestive Tract," 1907, page 226: Sulphur Compounds. The sulphur compounds resulting from putrefactive decomposition in the intestine, have received little attention from the standpoint of their pharmacological action. It is therefore difficult to form a just estimate of their importance for intestinal intoxications. It was claimed by Neneke that methyl mercaptan is one of the gases formed 4110 in the intestine during putrefaction. * * * It appears to me, therefore, not clear that the methyl mercaptan found by Neneke was formed during putrefaction outside the body. Page 241. Indol. It has long been known the Indol is a product of putrefactive decomposition of proteids. * * * The observation has been repeatedly made by clinicians that persons in whom a very strong indican reaction can be obtained * * * invariably suffer from nervous or dyspeptic disorders, and many careful physicians have believed in some casual connection between the observation of Indol from the intestine and the development of functional nervous or nutritional derangements."

Rideal in book entitled "Sewage," 1906, page 97, states: "The amount of oxygen required to render inoffensive the substances occurring in sewage depends on the species of the bacteria which are acting, as they determine whether the result should be complete burning to CO_2 , H_2O , and N , or a partial decomposition to equally harmless compounds like NH_3 and CH_4 . There are a number of intermediate products; thus *Streptococcus longus* liquefies fibrin to ammonia, methylamine, trimethylamine, tryosine, leucine, fatty acids, succinic acid, collidine and peptones. Elastine with anaerobic organisms, evolves CO_2 , H_2 , CH_4 , and N , whilst the sulphur remains in solution as mercaptan, and is not evolved as H_2S . Page 173: "It is a mistake to suppose that the odorous ingredients in sewage are all basic like ammonia, or readily combine with chemical reagents. * * * In distilling sewages or contaminated waters for ammonia and albuminoid, the distillate will be found to have a peculiar nauseous, somewhat aromatic odor, which is so constant that in waters it points strongly to sewage admixture. * * *

The compound collects as a greasy white scum on the top of the distillate. * * * It is very difficult to separate. In small quantities it floats like a grease on the surface of the water: from its odor and general occurrence though in minute amounts, it would seem to be an important cause of the residual sewage odor when ammonia, etc., have been removed. * * * Ethereal salts, 4111 like mercaptan, may also be mentioned among the many substances which may render chemical deodorization inefficient." Dunbar and Calvert, "Principles of Sewage Treatment" 198, Page 40: "Sewage Nuisances.—The most manifest nuisances which arise from present methods of sewage disposal are * * * the formation of sludge deposits * * * the turbidity and color of the water * * * the putrefactive changes which occur and give rise to all bad smells chiefly of sulphuretted hydrogen and also in the putrefying sludge which sometimes rises to the surface of the streams. Such nuisances have attained dimensions so serious in some districts that for long distances it is impossible to dwell on the banks or in the neighborhood of the rivers."

Q. In your opinion, Dr. North, do odors constitute a nuisance?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

A. They undoubtedly do. The creation of an odor is recognized by Public Health authorities as one form of nuisance against which their activities must be directed for the protection of public health. The odors created by putrefaction of sewage are among the most prominent of these. The creation of an odor by the putrefaction of sewage in New York Harbor and the transmission through the air of the Harbor to the inhabitants of New York City would be a menace to the health of said inhabitants. The effect of an odor depends upon two things—(a) the susceptibility of the persons affected, and (b) the character of the odor, or odors.

Q. Dr. North, in answering a question of mine earlier in your testimony, you stated that the effect of an odor nuisance depended upon two things, susceptibility of persons affected and the character of odors themselves. I now ask you what you mean by the "Susceptibility of persons affected," and ask you to give in detail the factors that either create or accentuate such susceptibility as is embraced in your expressed opinion?

Mr. Riker: The same objection.

The Commissioner: Note the objection of Counsel for Defendants.

4112 A. It can be shown that the inhabitants of New York City are peculiarly susceptible to the effect of odors. The character of life in New York City, the habits of the people and the nature of the business transacted in New York City exert influences upon the public health which are not experienced to the same degree in small communities. The most important of these influences may be characterized as under the title of "The pressure

of Modern Business." This pressure is exerted upon the individuals inhabiting the City in a number of direct ways. From the transactions of the New York Post Office published in the year 1893 to 1910, inclusive, the figures are given showing the quantity of first class mail matter received in incoming mails and originating in New York City. These together show the total number of letters handled by the Post Office in New York City each day. I submit in Table No. 1, a tabulation of these figures for the years 1893 to 1910, inclusive, which show that the total daily letters handled have increased from 1,051,000 to 2,663,000. This increase is illustrated graphically in Chart No. 1, which I also submit.

Transactions of the New York City Post Office Prepared for the Annual Report of the Chamber of Commerce by Direction of Hon. E. M. Morgan, Postmaster.

Average Quantities of Mail Disposed of in One Day for the Following Years.

	Originating in New York (outgoing.)	Received in mails (incoming.)	Total daily letters.
1893.....	901,363	150,140	1,051,503
1895.....	944,458	138,661	1,083,119
1897.....	1,044,656	157,825	1,202,481
1898.....	1,144,669	149,892	1,294,561
1900.....	1,372,006	208,074	1,580,080
1901.....	1,561,033	252,160	1,813,202
1902.....	1,657,160	273,582	1,930,742
1903.....	1,716,390	284,121	2,000,511
1905.....	2,059,455	327,874	2,387,329
4113			
1906.....	2,034,973	356,655	2,391,628
1907.....	2,108,738	307,975	2,506,713
1908.....	1,997,533	376,789	2,374,322
1909.....	2,201,916	383,739	2,585,655
1910.....	2,251,148	412,009	2,663,157

Q. Dr. North, who prepared the Chart No. 1, which you now produce?

A. I did.

Mr. O'Sullivan: I offer the Chart marked No. 1, prepared by this witness in evidence and ask that it be marked Complainants' Exhibit No. 207.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Received in evidence and marked Complainants' Exhibit No. 207.

The Witness (continuing): Another important factor in busi-

new pressure is the increase in passenger railroad traffic. In the Report published by the Public Service Commissioner of the State of New York, January 10th, 1912, is contained statistics of the city railway traffic of the City of New York from the year 1860 to the year 1911 inclusive. Among other figures it is shown that all of the street railways of Greater New York carried in the year 1860 a total of 50,830,173 passengers, while in 1911 the railways carried 1,551,144,963 passengers. The relation of the passengers carried to the population is shown in the tabulation which I submit under the title of "Table No. 2, Growth of City Railway Traffic in New York City" showing that the rides per capita were 43 in the year 1860, while in 1911 there were 315 rides per capita. This increase in railway passenger traffic is graphically illustrated in Chart No. 2 which is herewith submitted.

4114 *Growth of City Railway Traffic in New York City.*

Total Street Railways.

Year.	Per capita.
1860.....	43
1870.....	103
1880.....	152
1890.....	218
1900.....	246
1901.....	248
1902.....	256
1903.....	265
1904.....	274
1905.....	283
1906.....	301
1907.....	305
1908.....	303
1909.....	301
1910.....	312
1911.....	315

Q. Dr. North, who prepared the Chart No. 2, which you now produce?

A. I did.

Mr. O'Sullivan: I offer the chart marked No. 2 prepared by the witness in evidence, and ask that it be marked Complainants' Exhibit No. 208.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Received in evidence and marked Complainants' Exhibit No. 208.

The Witness (continuing): There is no one feature of modern business life which makes more constant demands upon the
 4115 attention and therefore upon the nervous system than the telephone. The growth of the telephone business is one of the wonders of modern business life. In the United States Census

report of 1907 there appears figures showing the growth of the telephones in service in the Boroughs of Manhattan and Bronx, City of New York. From these it appears that in the year 1881 there were 2,973 telephones in these Boroughs, while in 1907 there were 240,590. From the Report of the American Telephone & Telegraph Company of May 1st, 1912, figures showing the growth of telephones in the United States are given for the year ending 1910. These show that in 1895 there were 2,402,543 telephones in the United States, while in 1910 there were 22,284,010. I have estimated from these figures and other statistics in this report that the number of telephones actually in use in New York City in the year 1910 was 350,000. In Table No. 3 which I submit is a tabulation of the figures from the United States Census Report and also a statement of the population of the Boroughs of Manhattan and Bronx; I also submit Chart No. 3 which illustrates graphically the growth of telephone business in New York City. The number of telephone calls per day for each instrument increases with the number of instruments installed. For instance, the Report of the United States Census Bureau for 1907 states that in New York City, there were in the year 1902 4-1/2 telephone calls per station per day, while five years later, in the year 1907, there were five calls per station per day.

4116 *Number of Telephones in Service, New York City.*

a (Manhattan & Bronx.)

Date.	Telephones.	Population.
1881.....	2,973 (1880)	1,206,299
1889.....	7,454 (1890)	1,515,301
1894.....	11,218	
1898.....	23,046	
1899.....	28,423	
1900.....	40,437	2,050,600
1901.....	54,650	
1902.....	72,182	
1903.....	96,359	
1904.....	121,935	
1905.....	144,353	
1907.....	240,590	
1910.....	350,000 (estimated)	2,762,522

Q. Dr. North, who prepared the Chart No. 3, which you now produce?

A. I did.

Mr. O'Sullivan: I offer the Chart marked No. 3 prepared by this witness, in evidence and ask that it be marked Complainants' Exhibit No. 209.

Mr. Riker: Same objection.

The Commissioner: Note the objection.

Received in evidence and marked Complainants' Exhibit No. 209.

The Witness (continuing): The statistics of the Telegraph Companies are exceedingly meagre and the Census reports and Reference Books contain little information, for the reason that the Telegraph Companies have declined to furnish same. Statistical information contained in the Scientific American Reference Book 4117 for 1913, shows that the telegraph traffic increased from the year 1900 to 1910 to the extent of at least 35%. The Report of the American Telephone and Telegraph Company shows that the number of telegrams were equal to about 2 per cent. of the number of telephone messages in the year 1900, and about one per cent. of the number in the year 1910. In the United States, it is stated in this Reference Book, that for each 1,000 population in 1909, there were, 96,090 pieces of first class mail matter, 1,076 telegrams and 137,882 telephone conversations as against 90,062 pieces of first class mail, 1,039 telegrams, and 134,335 telephone conversations in the year 1908. From the figures given in the report of the American Telephone & Telegraph Company, I have estimated that in New York City there were in the year 1890, 20,000 telegrams, in 1900, 29,719 and in 1910, 33,289. The demands on the telegraph service, have, of course, been greatly decreased by the installation of the telephone. That the increase in telegraph messages as well as in other factors has been much greater in the United States than in Europe is illustrated in Table No. 4, which I submit herewith.

Percentages of Messages in the United States.

Traffic per 1,000 Inhabitants.

Mail, 40.9%.

Telegraph 0.4.

Telephones, 58.7.

	Europe.			United States.		
	Teleph.	Telegr.	Mail.	Teleph.	Telegr.	Mail.
1908.....	10,585	769	34,766	134,335	1,039	90,062
1909.....	11,400	798	35,533	137,882	1,076	96,090
Increase.....	7.7%	3.7%	2.2%	2.6%	3.5%	6.7%

Scientific American Reference Book 1913.

The growth of activity in the Post Office, Railroad transportation, Telephone and Telegraph must be measured against the growth in population to get a true index of the absolute increase in business pressure upon the inhabitants of New York City. I have, therefore, drawn up a table showing the population, the number of letters daily handled, the daily number of passengers carried by the New York City railroad lines, the number of daily telephone calls, and the number of daily telegrams sent and received for the years 1890, 1900 and 1910. These figures appear in Table No. 5, which I submit herewith. The growth of population and of these business activities is illustrated in Chart No. 5, which accompanies this Table.

Growth of Population and Business, New York City.

Population.	Letters.	Railroad passengers.	Daily communications.	
			Telephone calls, U. S.	Tele- graphs.
1890.....	2,420,817	1,000,000	232,800	20,000
1900.....	3,225,324	1,580,080	2,321,515	27,719
1910.....	4,776,883	2,663,157	3,961,945	33,289

Q. Dr. North, who prepared the Chart No. 5 which you now produce?

A. I did.

Mr. O'Sullivan: I offer the chart marked No. 5, prepared by this witness in evidence and ask that it be marked Complainants' Exhibit number 210.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Received in evidence and marked Complainants' Exhibit No. 210.

The Witness (continuing): Matters of public health must necessarily be considered in their relation to the individual. If the Post Office, Railroad, Telephone and Telegraph must be looked upon as irritations and as exerting an influence by their pressure upon the public health of the inhabitants of New York City, their effect must be exerted upon individuals. The figures already shown have been Office, Railroad, Telephone and Telegraph must be looked upon as reduced to a per capita basis for the years 1890, 1900 and 1910. I submit No. 6, which shows the increase for a period of twenty years from 1890 to 1910 of these various elements of business pressure. The total transactions per capita in the year 1890 were 391.64, and for the year 1910, 965.15; this means an increase of over 140 per cent. in business activity per capita. This increase is shown graphically in Chart No. 6, which is also submitted.

4119 *Summary Increase Business, New York, Twenty Years.*

Yearly Transactions per Capita.		
	1890.	1910.
Mail	146	200.75
Telephone	26	450.00
Railways	218	312.
Telegraph	1.64	2.40
Total Transactions.....	391.64	965.15

From "Telephone Statistics." American Telegraph & Telephone Co. May 1912.

Scientific American Reference Book, 1913.

Transactions New York Post Office Annual Reports. Chamber of Commerce.

Q. Dr. North, who prepared the Chart No. 6, which you now produce?

A. I did.

Mr. O'Sullivan: I offer the Chart marked No. 6 prepared by this witness, in evidence, and ask that it be marked Complainants' Exhibit No. 211.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Received in evidence and marked Complainants' Exhibit No. 211.

The Witness (continuing): The health of the business man has been affected to a greater degree by the growth of corporations than by any other one factor. That form of business organization known as a corporation takes the least account of the personal interest of its employees. Ruled by the Board of Directors and inspired only by the desire to pay the interest on capital stocks and bonds, corporations look upon individuals only as machines to be cast aside as soon as there is any sign in the individual of decreasing efficiency. As a consequence, persons employed by corporations recognize that the corporation is a heartless creature and that to work at top speed and at highest efficiency is their only chance of holding their 4120 positions. The health and vitality of the employees is therefore taxed to the utmost and cannot receive the consideration from the corporation which they receive from private employers. The growth of corporations in any community must, therefore, be looked upon as having a most serious relation to the public health.

In New York State records have not been kept accurately until recent years, and consequently, a full tabulation of the corporations formed cannot be obtained. I submit below Table No. 6A, which is copied from the Second Annual Report of the Secretary of State of New York for the year 1912. I also submit Chart No. 6A, which shows graphically the growth of the number of corporations formed each year as indicated by the figures in the above table.

From these facts it appears that from the year 1901 to 1912, the number of corporations formed in the State of New York each year increased from 2,670 to 8,757 which means a multiplication of about $3\frac{1}{3}$ times. It is common knowledge that corporations have increased most rapidly in most recent years. Figures are not available for the years previous to 1901. If the rate of increase were the same for the ten years previous to 1901, there would have been formed in the year 1892 only 800 corporations. This would mean that during 20 years previous to 1912 the number of corporations formed in New York State each year had multiplied ten times. When one considers the numerous corporations in the State of New Jersey and in other States which have their offices in New York City, it is not unreasonable from the figures above shown to assume that during the past 20 years corporations formed each year have multiplied at least ten times. Compared with this the population of New York City has only doubled—consequently, there are now five times as many corporations per capita as there were 20 years ago. Assuming that the average number of persons employed by each corporation was the

same 20 years ago that it is today, these figures mean that five times as large a proportion of the community is now employed by corporations as there was 20 years ago.

4121 When one considers the great increase in the size of larger corporations and therefore in the number of persons employed by each, this estimate appears a conservative one. The corporation tax on the health of the business community is the greatest of all taxes. It is a tax on the nervous system and on vitality which is felt most potently in a great metropolis like New York City.

Stock Corporations Formed Each Year, January 1 to December 31, 1901-1912.

From Second Annual Report of the Secretary of State of New York, 1913.

1901	2,670
1902	3,577
1903	3,887
1904	4,420
1905	5,609
1906	6,347
1907	6,599
1908	7,185
1909	8,328
1910	7,998
1911	8,357
1912	8,757

Q. Dr. North, who prepared the Chart No. 6A, which you now produce?

A. I did.

Mr. O'Sullivan: I offer the Chart marked No. 6-A prepared by this witness, in evidence, and ask that it be marked Complainants' Exhibit No. 211-A.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Received in evidence and marked Complainants' Exhibit No. 211-A.

4122 The Witness (continuing): Another increasing tax on the vitality of the inhabitants of New York City, particularly the business men is their habit of sedentary life. This means indoor life and inactive life so far as the muscular system is concerned. The increasing demands upon individuals required his presence at headquarters and in offices to which the various communications before mentioned come, and the habit of physical inactivity and a consequent degeneration of the muscular system and physical energy of business men has resulted.

Authorities are agreed that there is no system of ventilation which can make indoor air as pure as outdoor air in a closed room without

creating a draft, consequently dwellings and offices of New York City contain air which is much inferior for breathing purposes to outdoor air. Indoor life and office life mean the breathing of inferior air with a consequent tax on vitality. As business has increased and office life has increased the effect of impure air has also increased.

Q. Dr. North, what have been the results of the various factors that you have now given in detail on New York City life and on New York City diseases and the susceptibility of citizens of New York City, toward these odor nuisances that you already mentioned?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. As a result of the characteristics of New York City life above mentioned, there has been a great change in the character of diseases from which the inhabitants suffer and in the relative importance of the several causes of death. The activities of sanitary authorities have greatly decreased those deaths which are due to bacteria, namely the so called infectious diseases. On the other hand those diseases which are due to a degeneration of the vitality and of the physical organization have greatly increased in recent years. Also diseases resulting from taxation of the nervous system have greatly increased. These facts are supported by the following evidence: Typhoid fever, being a disease which is most frequently transmitted by water and milk, has been greatly reduced through the activities of the health authorities by the purification of the water supply and the milk supply of New York City. From the annual report of the Department of Health of New York City for the year 1908, figures are taken which show that the decennial death rate in the year 1868 was .31 per thousand, while in the year 1908 it was .17 per thousand, a reduction of more than 50 per cent.

The most important infectious disease from which human beings suffer is Tuberculosis. The deaths from this disease have been greatly reduced through modern methods of treatment and through measures of prevention which have been instituted by the public health authorities. The statistics of the New York Department of Health, published in their annual report for 1908 show that in the year 1868 the decennial death rate from tuberculosis was 3.76 per thousand, while in the year 1908 the decennial death rate was 2.23 per thousand. This is a reduction of more than 40 per cent. If we turn, however, to diseases caused by degeneration and with which bacteria have no concern, we discover a startling state of affairs. The vital statistics of the New York City Department of Health for the year 1908 show that in 1868 the decennial death rate from Bright's Disease was .67, while in the year 1908, the decennial death rate from Bright's Disease was 1.39, an increase of over 100 per cent. Another disease which is due to degeneration is Heart Disease. The vital statistics of the New York City Department of Health for the year 1908 show that in the year 1878 the decennial death rate from Heart Disease in the city was 1.11, while in the year

1908 the decennial death rate was 1.40 an increase of about 27 per cent. These facts are shown in Table No. 7 and are shown graphically in Charts No. 7-A, 7-B, 7-C and 7-D.

4124 *Decennial Death Rate in Infectious Diseases and Degenerative Diseases.*

New York City.

1868-1908.

Infectious Diseases vs. Degenerative Diseases.

Dates.	Typhoid.	Tuberculosis.	Bright's disease.	Heart disease.
1868 .....	.31	3.76	.67	
1873 .....	.31	3.76	.62	
1878 .....	.28	3.58	.84	1.11
1883 .....	.29	3.58	.84	1.11
1888 .....	.20	2.76	1.16	1.28
1893 .....	.20	2.76	1.16	1.28
1898 .....	.18	2.24	1.39	1.38
1903 .....	.18	2.24	1.39	1.38
1908 .....	.17	2.23	1.39	1.40

From Annual Report Department of Health City of New York, 1908.

Q. Dr. North, who prepared the charts Nos. 7-A, 7-B, 7-C and 7-D?

A. I did.

Mr. O'Sullivan: I offer the charts marked respectively, numbers 7-A, 7-B, 7-C and 7-D prepared by this witness, in evidence,
4125 and ask that they be marked respectively, Complainants' Exhibits Nos. 212-A, 212-B, 212-C, and 212-D.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Received in evidence and marked Complainants' Exhibits Nos. 212-A, 212-B, 212-C, and 212-D.

The Witness (continuing): City life in New York levies its heaviest tax on the nervous system. The capacity of institutions for the insane is constantly increasing faster than the population is increasing. Figures showing the insane from New York City as distinguished from the rest of the State are not available. Figures for the entire State are shown in the Twenty-third Annual Report of the State Commission in Lunacy of the State of New York. From this report it appears that in the year 1889 there were 255.2 patients in institutions for the insane for each 100,000 population. In the year 1911, there were 355 patients in such institutions for each

100,000 population—being an increase of 40 per cent. These facts are shown in Table No. 8 which I submit, and in Chart No. 8 attached. It is in the milder forms of insanity, however, that the greatest increase has occurred. There are more patients outside of the institutions at the present time than in former years. The increase in neurasthenia and melancholy is alarming to the medical profession. The various manifestations of nervousness due to over taxation of the nervous system by attention to business is a matter of common knowledge.

Number of Patients in Institutions for the Insane in New York State to Each 100,000 Population.

Year.	Total.
1889.....	255.2
1890.....	259.3
1891.....	265.1
1892.....	272.3
1893.....	282.3
1894.....	288.8
1895.....	300.8
1896.....	305.6

4126

(Continued.)

Year.	Total.
1897.....	312.4
1898.....	317.6
1899.....	321.6
1900.....	327.1
1901.....	327.3
1902.....	329.3
1903.....	334.7
1904.....	339.7
1905.....	339.7
1906.....	341.9
1907.....	342.6
1908.....	349.6
1909.....	352.9
1910.....	358.3
1911.....	355.4

Twenty-third Annual Report State Commission in Lunacy, State of New York, p. 214.

Q. Dr. North, who prepared the chart No. 8, which you now produce?

— I did.

Mr. O'Sullivan: I offer the chart marked No. 8 prepared by this witness, in evidence and ask that it be marked Complainants' Exhibit No. 213.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Received in evidence and marked Complainants' Exhibit No. 213.

The Witness (continuing): My researches regarding the increase in degenerative diseases are supported by the studies of life insurance companies. The increase in degenerative diseases and in insanity and nervous diseases is fully appreciated by these Life Insurance Companies. Two of the largest Companies have already established departments devoted to a special study of the alarming increasing in American people of the diseases peculiar to American life. In a publication entitled "American Life-Waste," published by the Postal Life Insurance Company, the statement is made—"An analysis of the available statistics shows that a decline in the death rate has occurred chiefly in the diseases of children, and early adult life, and comes almost wholly from tuberculosis, typhoid, diphtheria and other diseases of the communicable class.

* * * But the death rate from cancer, kidney, heart and similar non-communicable diseases, against which no warfare has been waged, is not only very high, but in most instances has shown a remarkable increase. * * * Chart No. 8 shows a truly remarkable increase. * * * Chart No. 8 shows a truly remarkable increase in the mortality from degenerative diseases, i. e. affections of the heart, blood vessels and kidneys, dropsy, etc. 104 per cent. since 1880. * * *

Chart No. 9 showing a very heavy increase in the mortality from degenerative diseases during the most productive years of life, amounting to 60 per cent. between the ages of 40 and 50." In another publication entitled "The upward trend of Mortality in Middle Life and Old Age" by E. E. Rittenhouse, Conservation Commissioner of the Equitable Life Assurance Society of the United States, the statement is made—"The mortality rate from apoplexy, paralysis, diseases of the heart, circulatory system, kidneys and liver, has heavily increased in the younger as well as in the older groups. The total deaths were 367,700 in 1910." "In Massachusetts the death rate from these causes has increased 86.4 per cent. in 30 years." "In sixteen important cities the death rate from organic diseases of the heart, and from apoplexy, Brights and nephritis has alone increased 94 per cent. in 30 years."

"The death rate of the total population, age 40, and over, has increased, 1910 over 1880:

In Massachusetts and New Jersey, 30 years.....	21.2%
in 16 Cities, 30 years.....	25.3%
4128 In 10 states, 10 years (1900-1910).....	3.0%

The increase in the proportion of older lives in our population has been very slight and does not account for the increase in the death rate."

While nervous and degenerative diseases are recognized as peculiar to American life, the conditions causing them are greatest in New York City. The Bureau of Records of the Department of Health has just published a tabulation showing the approximate life table

for the City, and the expectation of life of the inhabitants of the City at different ages. This table shows that while there has been an increase in the life of persons below the age of forty years during a period extending from 1881 to 1911, yet during that same period there has been a net loss in the length of life in persons over the age of 40 years. These facts are shown in Table No. 9 and in Chart No. 9, which I submit herewith.

4129 *Approximate Life Table for City of New York Based on Mortality Returns of Triennia- 1879 to 1881 and 1909 to 1911.*

Age.	Expectation of life.						Gain (+) or Loss (-)		
	1879-1881.			1909-1911.			in years of expectation.		
	Males.	Females.	Persons.	Males.	Females.	Persons.	Males.	Females.	Persons.
—5..	39.7	42.8	41.3	50.1	53.8	51.9	+10.4	+11.0	+10.6
5..	44.9	47.7	46.3	49.4	52.9	51.1	+ 4.5	+ 5.2	+ 4.8
10..	42.4	45.3	43.8	45.2	48.7	46.9	+ 2.8	+ 3.4	+ 3.1
15..	38.2	41.2	39.7	40.8	44.2	42.5	+ 2.6	+ 3.0	+ 2.8
20..	34.4	37.3	35.8	36.6	40.0	38.3	+ 2.2	+ 2.7	+ 2.5
25..	31.2	34.0	32.6	32.7	36.0	34.3	+ 1.5	+ 2.0	+ 1.7
30..	28.2	31.0	29.6	28.9	32.1	30.5	+ 0.7	+ 1.1	+ 0.9
35..	25.3	28.1	26.7	25.4	28.4	26.9	+ 0.1	+ 0.3	+ 0.2
40..	22.5	25.2	23.9	22.1	24.7	23.4	- 0.4	- 0.5	- 0.5
45..	19.8	22.4	21.1	18.9	21.1	20.0	- 0.9	- 1.1	- 1.1
50..	17.2	19.4	18.3	15.9	17.7	16.8	- 1.3	- 1.7	- 1.5
55..	14.5	16.4	15.4	13.2	14.6	13.9	- 1.3	- 1.8	- 1.5
60..	12.2	13.8	13.0	10.8	11.8	11.3	- 1.4	- 2.0	- 1.7
65..	9.9	11.2	10.5	8.8	9.4	9.1	- 1.1	- 1.8	- 1.4
70..	8.5	9.3	8.9	6.9	7.5	7.2	- 1.6	- 1.8	- 1.7
75..	7.1	7.5	7.3	5.3	5.7	5.5	- 1.8	- 1.8	- 1.8
80..	6.2	6.5	6.4	4.1	4.5	4.3	- 2.1	- 2.0	- 2.0
85—	5.4	5.5	5.5	2.0	2.4	2.2	- 3.4	- 3.1	- 3.3
							+24.8	+28.7	+26.6
							-15.3	-17.6	-16.6
							+ 9.5	+11.1	+10.0

4130 Q. Dr. North, who prepared Chart No. 9 which you now produce?

A. I did.

Mr. O'Sullivan: I offer the Chart marked No. 9 prepared by this witness in evidence and ask that it be marked Complainants' Exhibit No. 214.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

Received in evidence and marked Complainants' Exhibit No. 214.

The Witness (continuing): In the people of New York City, we therefore, have to deal with a population which is undergoing the maximum tax of business pressure and upon whom the character of life and work has already begun to show its results in a most alarming increase of degenerative and nervous diseases. It is impossible to conceive of a population more susceptible to damage through alterations in the character of the atmosphere which they breathe. Air pollutions which might have little effect upon the health of persons in more favorable environment will have a profound effect upon the

health of such a population as is found in New York City. Any factors such as an odor nuisance polluting the air of New York City would injure not only the health of the inhabitants but also minimize their efficiency and thereby would affect the prosperity of the entire country.

Mr. O'Sullivan: That is all.

Cross-examination by Mr. Riker:

Q. Do I understand you to say that you do not believe Mr. Johnson's statement that the gas that he mentioned was the most offensive to him?

A. No, sir, I did not say that.

Q. Then you don't mean to be understood as meaning that, do you?

A. I do not know what Mr. Johnson thought.

Q. You read his testimony, didn't you?

A. Yes, sir.

Q. Don't you know what he said he thought?

A. I know what he said he thought.

Q. Do you doubt that?

4131 A. I doubt it, because he qualified his statement at the end of his testimony.

Q. Then you don't doubt his statement, as he made it, do you?

A. I doubt the truth of it.

Q. You doubt the truth of the fact that he thought that that was the most offensive to him?

A. I don't know how far I can go into Mr. Johnson's psychology.

Q. Well, that is the testimony you were asked to refute?

A. He made the statement that indol was the most offensive gas.

Q. To him; don't you remember that he qualified it by making it a matter of a personal equation?

A. Well, the record will show whether he did; I can not remember the exact words.

Q. Well, you are testifying in rebuttal or supposed to be testifying in rebuttal as to what he said; you don't remember what he said?

A. I remember he said indol was more offensive than the other gases.

Q. To whom?

A. I don't recollect.

Q. So far as you are concerned you don't consider it the most offensive?

A. Why, I don't base my opinion entirely upon my own experiences with it.

Q. I am not asking you that; I am asking you whether you personally considered it the most offensive?

A. No, I do not.

Q. If Mr. Johnson did consider it so, you don't agree with him; is that all there is to it?

A. That is not all there is to it, no. I know of other authorities who join me in my opinion.

Q. Well, do you agree with it?

A. No, sir.

Q. Now, the injury from odors that you have been asked to testify in regard to, have you noticed any injury to health along the water front in New York that you could trace to a discharge of sewage into the waters of New York Bay?

A. I think the air of New York City has a very intimate relation to the health of the inhabitants.

Q. Won't you answer my question, Dr. North?

A. I think that is a sufficient answer to it.

Q. You think that is the answer to the question? Will
4132 you read my question, Mr. Stenographer?

The stenographer thereupon read the question.

Q. Now, what answer do you make to it?

A. The records of the Department of Health of New York City show that the health of the people who live in those sections of the City is affected by diseases which are peculiar to New York City and New York City life, all of which are shown in the charts and tabulations which I have submitted.

Q. Is that the answer which you want to stand by to that question?

A. Yes, sir.

Q. You have no other answer to make?

A. I think that includes the people who live on the water front.

Q. I ask you again whether there is any disease or any effect upon the health of the citizens of New York, the residents of New York, along the water front, that you personally traced to the odors produced by sewage discharged into the waters of New York Bay?

A. I don't see how that question can be answered in any other way than the way I have answered it. As a sanitarian, I am perfectly familiar with the effect of air on health, and I have personally looked into the records of the City of New York, Department of Health for the purpose of ascertaining whether there are diseases in the City that are caused by the air and pollutions of the atmosphere.

Q. I asked you the direct question as to your personal determination of any injuries affecting the residents along the water front of New York, due to the odors produced by the sewage discharged into the waters of New York Bay; can you give me that?

A. I can only answer the question as I have answered it.

Q. Do you know that all the sewage of New York City is discharged along the water front?

A. Yes, sir.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Do you know whether or not the sewage discharged
4133 from New York City is particularly fresh sewage?

A. Yes, sir, I know that it is fresh sewage.

Q. Were you describing in your testimony the putrescent gases given off by septic sewage principally and their effects on health?

A. Yes, sir.

Q. Are the stevedores and other employees working on the water front particularly noted for physical vigor and as a class small in number?

A. Yes, sir.

Mr. O'Sullivan: That is all.

Mr. Riker: That is all.

Adjourned to June 6th, 1913 at 10:30 A. M.

4134 Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWAGE COMMISSIONERS, Defendants.

NEW YORK CITY, June 6th, 1913—10:30 a. m.

Before James D. Maher, Esq., Commissioner.

Appearances:

William J. O'Sullivan, Esq., Special Counsel for the People of the State of New York, Complainants;

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

WILLIAM T. SEDGWICK, a witness in behalf of the Complainants, recalled in rebuttal, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Professor?

A. William T. Sedgwick.

Q. Did you testify in this suit before?

A. I did.

Q. Was your attention, Professor Sedgwick, directed to
4135 the testimony given by Mr. Asa Henry Phillips, Mr. William M. Brown, General Henry Martin, Robert and Mr. George

A. Johnson?

A. It was, and I examined their testimony.

Q. Have you any knowledge of the Sewage Disposal Works at Washington, D. C.?

A. I have, having visited them with Mr. Phillips, the Engineer in charge.

Q. Will you state whether or not you consider the conditions at

Washington are such as to make that system fairly comparable with the proposed Passaic Valley Trunk Sewer System?

A. I do not.

Q. Why?

A. Because to begin with, Washington being comparatively small city, produces a comparatively small amount of sewage. Moreover this is mostly domestic sewage and remarkably free from trades wastes of all kinds. In the next place, the disposal, made under the surface, is into a tidal river of fresh water. The Potomac River, moreover, is limited above by the so-called Point of Rocks, so that instead of a long, level and deep trench or trough, such as we have in the Hudson River, from the Narrows to Albany or Troy, we have in the Potomac a long and shallow estuary stopped at the upper end. While the Washington sewage is poured into this stream, not as would be the case at Robbins Reef in water of such saltness as enables oysters to grow in the vicinity, but rather many miles above any point at which it is deemed possible to cultivate oysters; that is to say into water virtually fresh. The Washington analogy, therefore, has no value, unless it is proposed to pour the Passaic Valley sewage into the Hudson at some point above Poughkeepsie, and the Washington system is accordingly in no wise comparable with that proposed for the Passaic Valley.

Q. Have you knowledge of any sewage disposal plants, employing sub-surface disposal in salt or brackish waters?

A. I have.

Q. Will you name some of them Professor Sedgwick?

A. Beverly, Massachusetts, Salem, Massachusetts, and Boston are three that I am more or less familiar with.

Q. Will you describe the Beverly outfall and the effects of 4136 the discharge of sewage through that outfall?

Mr. Riker: The question is objected to as not being rebuttal. The Commissioner: Note the objection of Defendants' Counsel.

A. The City of Beverly having a population of upwards of 40,000, empty its sewage into Beverly Harbor, but within a few hundred feet of the shore and at a depth of perhaps 10 feet below low tide. The result is that objectionable conditions have arisen, complaints have been made, and a different system of disposal is now under consideration by Beverly.

Q. Will you describe the Salem outfall and the effects of the sewage discharged therefrom?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The sewage of Salem and one or two manufacturing towns in its vicinity, having a combined population of 50,000 or more, is poured into Salem Harbor, at a point perhaps 2 miles away from the shore front but still inside the Harbor near Great Haste Island. This disposal plant is comparatively new and the sewage is delivered upwards from a pipe which comes nearly to the surface at low tide. The result is that in summer, and especially at low tide,

sewage fields are formed over the outlet and in the vicinity and yachtsmen, of whom there are many at Marblehead, Manchester and Salem, are in the habit of avoiding this particular region when possible, because of the disagreeable sights and odors prevailing in the vicinity of the outlet.

Q. Will you describe the Boston system of sewage disposal into Boston Harbor, Professor Sedgwick?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. In the case of Boston, there are three outlets, the oldest known is the Moon Island outlet from which the sewage of the old City of Boston is discharged, but only upon the ebb tide. In the 4137 Moon Island system, the sewage is held in large reservoirs, between tides and then allowed to flow out rapidly on the ebb tide at what is practically the surface. I have investigated these dispersions of sewage from this outlet and have been able to trace it far down the Harbor and over a wide area, but it is a notable fact that it does not appear to be carried back or upwards towards the City to any great distance, a fact which seems to show that the prevailing movement of the water in Boston Harbor is downward toward the sea. The second outlet in point of age, is that known as the Deer Island outlet, from which are discharged daily about 60,000,000 gallons of sewage, at a point very near the Deer Island Lighthouse and the Broad Sound Channel, from a pipe turned upwards and located not much below the level of the sea at low tide. This system was put into operation in 1905 and I have frequently seen in the vicinity large sewage fields, easily perceptible to the eye, and giving off a strong stench of sewage. One of the lighthouse keepers nearly had last year an attack of typhoid fever, which was attributed directly to the sewage. Fishermen are often seen gathered about the outlets, doubtless because fish find abundant food in the sewage. At low tide, a low fountain or spring of sewage can be seen boiling up or rising above the level of the sea like a low sewage water spout. From this outlet sewage is discharged continuously, and is therefore carried necessarily on the flood tide for some distance toward the City. Passengers on steamboats and ships entering or leaving the harbor in summer, at low tide, are often affected by the odors encountered in the vicinity of the Deer Island outlet. The third and latest outlet is that known as the Nutt Island outlet. This is situated in the southeastern part of the harbor, opposite to the Deer Island outlet—which is on the northeastern shore—and it is this which most resembles the outlet proposed at Robbins Reef. As in the case of Deer Island, the outlet is here also below the surface, but in this case, instead of ending just below sea level at low tide, it is placed some 30 feet below that level. the pipe 4138 which constitutes the outlet proper turning upwards, so that while in operation the stream of sewage is directed toward the surface from the bottom of the harbor. To this outlet goes by gravity continuously, through the whole 24 hours, the sewage of a portion of Boston proper, together with that from the City of

Newton, the town of Brookline, and various other places. The amount at present discharged through this outlet is about 40,000,000 gallons daily. Here, also as at Deer Island, abundant evidence exists at low tide, and especially in warm weather, of the presence of sewage upon the surface of the water. Here, also, a low spring, spout or fountain can be seen at low tide, rising above the level of the sea, caused by the upward rush of the volume of sewage ejected from the pipe. So high and strong is this spout or spring that it is not very easy to drive a motor boat over it, while in the immediate vicinity of the sewage fountain abundant evidences of raw sewage, such as discoloration, pieces of paper, bits of orange peel, particles of rags, oily material and other substances characteristic of sewage, abound upon the surface of the water. Inasmuch as it has been testified in this case that experiments have been made by pumping colored water to various depths in the vicinity of Roblins Reef without causing any appearance of color upon the surface in that vicinity, I recently made an experiment with the aid of assistants, in which I introduced into the trunk sewer leading to the outlet at Nutt Island, at intervals of 10 minutes, various quantities of a powerful dye known as eosine, dissolved in water, and then awaited the arrival of the dye at the sewage fountain in the harbor. As a result I had no difficulty in securing abundant evidence of the ready passage of the dye through the sewer to the surface, the surface of the sea being highly discolored on the arrival of the eosine. This experiment, however, was superfluous, because as I have already stated, there is always at low tide constant and abundant evidence of the arrival of vast quantities of sewage on the surface easily visible to the naked eye.

4139 Q. Professor Sedgwick, will you compare that Boston Sewage Disposal System at the Nutt Island outfall, with the proposed trunk sewer project of discharge contemplated by the Passaic Valley Sewerage Commissioners?

Mr. Riker: The question is objected to for the same reasons.

The Commissioner: Note the objection.

A. The Boston plant is in my opinion, the only one in America, if anywhere, which is to any extent comparable with that proposed for the Passaic Valley, and even the Boston system, closely examined, is so different in almost every respect as to be of but little value for this purpose. To begin with the physical conditions which prevail in Boston Harbor are totally unlike those prevailing in the upper harbor at New York. In the latter we have what is virtually a shallow lake, traversed by a deep trench or trough, this lake being hardly more than an enlargement or local distension of the Hudson River. The East River, as is well known, is essentially an oscillating water pendulum and contributed but little to the circulation of the Upper Harbor. The Hudson River, of which the Upper Bay is virtually an enlargement, is a mere long, level and deep trench or fiord extending from the sea to Albany or above, tidal effects being felt as far away as Albany and the water being brackish as far at least as Poughkeepsie. The Kill van Kull and

Newark Bay are comparatively shallow and comparatively unimportant. Boston Harbor, on the other hand is in no sense a river or an enlargement of a river, but rather a broad bay filled with islands, a dozen or more in number, and provided with abundant openings to the sea, two of which at a considerable distance apart, are deep ship channels, through which the waters of the harbor can circulate freely. One of these, the Main Ship Channel, debouches to the east, the other, the Broad Sound Channel to the northeast, while a third, narrow but deep, and known as Shirley Gut, when the wind is north or south, contributes materially to the harbor circulation. Moreover, Boston Harbor has at its upper end,

4140 no tidal reservoir comparable with the great Hudson River, but ends quickly in several small streams or bays, so that

the general configuration of the harbor may be likened to the palm of a hand, ending above in short and comparatively insignificant fingers, but opening below by a wide wrist-like connection with the sea.

From all this it follows that winds, from various directions materially influence the circulation of the waters of the harbor and contribute materially to whatever success may be claimed for the Boston system. These physical features, therefore, make the Boston system absolutely different from any which it is possible to create in the Upper Harbor of New York. One other condition of great importance must be mentioned, and that is the difference in the rise and fall of the tides, those at New York ranging from 3 to 6 feet only, while those at Boston range from 6 to 13 feet. So that, the fresh-ning action of the tides is obviously about double in Boston what it would be in New York. The absence also, as already indicated, of any capacious tidal prism or reservoir in Boston comparable to that furnished by the Hudson River, doubtless keeps the sewage largely in the Lower Harbor at Boston and forbids its carriage by the flood tides far inland as happens in New York. It would also appear that the Boston sewage at least at the Nutt Island outlet is much less septic than the Passaic Valley sewage would be, since only 6 or 8 hours appear to be necessary to bring the principal flow to the Nutt Island outlet, while at least double that time would probably be required to bring that of the Passaic Valley to Robbins Reef. Another item of difference is the fact that whereas the Hudson River is itself heavily polluted with sewage, whatever water finds its way into the upper portions of Boston Harbor is comparatively pure.

Q. Professor Sedgwick, do you know of any system anywhere so closely resembling the proposed Passaic Valley Sewerage System as to enable any one to predict with certainty that the latter will be successful?

A. I do not.

4141 Q. In your opinion is the Passaic Valley Trunk sewer project an experiment?

A. It would certainly be an experiment, but not an experiment in which the chances of success or failure would be equal. On the contrary in my opinion from what we know about other systems,

of disposal, into salt water, taken together, with the conditions existing in the Upper Bay at Robbins Reef, I consider it a very dangerous experiment and one probably doomed to early failure.

Q. Why?

A. For the reason that the Upper Harbor is already heavily and dangerously polluted with sewage, so that to add to the burden of filth, which it already carries, that which would inevitably come from the Passaic Valley, would be to invite disaster.

Q. What do you mean by "invite disaster"?

A. I mean to so increase the burden of filth already borne by the water of the Upper Bay as to exhaust its powers of oxidation, which are already seriously impaired, at times, thereby bringing on a condition of putrefaction which would turn the Upper Harbor and a considerable portion of the Hudson River, into a body of sewage, a kind of cesspool, in which neither fishes nor vegetable life could exist, and from which nauseous, disgusting and dangerous odors, due to the gases of putrefaction, would arise, creating a menacing odor nuisance.

Q. What effect, if any, would this malodorous condition have upon the public health?

MR. Riker: The same objection.

The Commissioner: Note the objection.

A. It would, I believe, diminish vital resistance to disease and cause lassitude, loss of sleep, headaches, malaise, and possibly even nausea at times among people living within its reach, that is, within the Metropolitan district. My reason for holding this opinion is that I have myself lived at one time adjoining the Back Bay water of Boston, and that I have been obliged sometimes, at night, to close the windows of my apartment, because of the nauseating odors proceeding from the sewage polluted water which formerly at low tide filled that Bay. I have also known of similar nausea and sickness produced by the sewage polluted Blackstone River at the Town of Millbury, and it is a well known fact that steamboat men and passengers have sometimes at low water in sewage polluted rivers, been taken violently ill from the stench in the rivers. It is also agreed among sanitarians that the pollution of foreshores and coastal waters with sewage is a menace to the public health. It has been observed, for example, that on the English coast, the crude sewage upon the foreshores appears to have caused a very much higher mortality from typhoid fever than existed in other parts of the country, an excessive mortality, which has been attributed by competent authorities to the coastal pollution. Sore throats have also been observed to prevail in the vicinity of highly polluted sewage polluted sea waters. Other ailments which have been noted in such cases are diarrhea, prostrations, headaches, loss of appetite and a general lowering of health with malaise. These conditions prejudicial to the public health appear to be due to what are sometimes called effluvium nuisances; that is to say gases arising from putrefying mixtures of sewage and water, or to sewage deposits from either or both of which sulphure-

ted hydrogen and other poisonous gases readily arise. When these deposits are laid bare by the tides if that happens there is also danger of insect transmission of living micro-organisms from the mud to people in the vicinity. So that, summing it all up, we may say that while it is often difficult to prove any increase in the presence of infectious diseases from exposure to sewage polluted waters, stinking waters or exposed flats, such increase has in fact, in my opinion, reasonably contributed to these causes and constitutional effects are unquestionable, for, as I say, I have myself witnessed and experienced some of them.

Mr. O'Sullivan: Your witness.

4143 Cross-examination by Mr. Riker:

Q. What is the population of Washington?

A. Washington?

Q. Yes.

A. 350,000.

Q. At what point is the locality of the rocks with reference to the city?

A. It is opposite the upper end of the City.

Q. What is the volume of the Potomac River at Washington?

A. I don't know.

Q. Do you think that the Potomac River at or above Washington is as desirable a place to dispose of sewage of 350,000 inhabitants as Robbins Reef?

A. Why, yes, I think so, more desirable.

Q. More desirable? Why?

A. Because the stream is mainly downwards.

Q. Is it a tidal stream?

A. Yes.

Q. How high does the tide rise at Washington?

A. I do not know exactly, but it is low, two or three feet.

Q. When the tide rises is the water backed up along the shores of the City of Washington?

A. To some extent, yes.

Q. Do you think that without reference to the volume of the water in the Potomac River, that it is as desirable a place to discharge sewage of 350,000 inhabitants as Robbins Reef?

A. I think so, because that backing up is only occasional, the river is a big river, most of the stream is downward; besides they have got to put it somewhere and that seems to be one of the best places.

Q. You are now dealing with the argument of necessity, are you?

A. Well, I mentioned that, yes.

Q. Is that the reason why you think the disposal at Washington is not comparable with that at Robbins Reef?

A. No, that is not the main reason; it is one reason. Robbins Reef is not the only possible place by any means.

Q. But leaving the question out entirely of any surrounding

cities, and dealing purely with the effect upon the water itself, you think that it is as desirable to discharge the sewage of 350,000 people into a water of the size and character of the Potomac River as to discharge it at Robbins Reef?

A. Well, I suppose you mean as to the discharge of the Passaic Valley at Robbins Reef?

Q. No, I am talking of the same population?

A. Of the same population?

Q. Yes.

A. That is a question of course, that I have not considered. As desirable, I think you said; wasn't that it?

Q. Use any expression you want, Professor; I don't insist upon splitting hairs in this question; I want to know as to the effect upon the water?

A. Oh, I think it is desirable. I think it would have a less effect upon the water. I think it is more desirable and would have a less effect upon the water of the Potomac River than it would at Robbins Reef.

Q. And why?

A. Because the water of the Potomac River is almost constantly moving downwards, so that the dilution would be rapid with the oxygen loaded water, and the thing is in fact well taken care of down below and the conditions seem to me so different, that I should rather put it in at Washington than at Robbins Reef, under present conditions.

Q. And having observed the effects of the Washington disposal and finding that they are not injurious, you think the conditions are better for the discharge there, isn't that all your testimony means?

A. I did not say that they are not injurious, at least, if I did, I should not have said so. I said that in my opinion and I will now say in my opinion they do not conspicuously affect the water there, but they have caused a great deal of trouble with the oysters below, they are alleged to have caused, and while the thing works superficially pretty well, I do not like that kind of a disposal anyhow, and I would like to get rid of it. But if I had to choose between the two, I would rather put it in there than at Robbins Reef.

Q. What is the flow of the Potomac River?

A. I don't know.

Q. Didn't you say that one of the reasons was because of the superior dilution of the Potomac?

A. No, I said it was a steadily downward flow. Yes, dilution, that is so.

Q. Well, if the flow was an inconsiderable amount, even though it is downward, do you think that affects dilution?

A. No, it is not inconsiderable.

Q. Do you know what the flow is?

A. No, I do not.

Q. How can you testify as to the dilution then?

A. Because I have seen it.

Q. Do you know the amount of it?

A. No.

Q. Have you seen the location at Robbins Reef?

A. Yes.

Q. Do you know what the dilution is?

A. No.

Q. Do you know the flow there?

A. No.

Q. Then how are you ever to testify as to the relative dilution then?

A. I did not say anything about it.

Q. What is there in the condition of the Potomac River that renders it superior for digesting sewage than the water of Robbins Reef?

A. Oxygen.

Q. In what respect and how does it happen that the oxygen of the Potomac River is superior to that of New York Bay at Robbins Reef?

A. The oxygen is not superior.

Q. Well, then, in what respect is the oxygen more effectual in the Potomac?

A. Because the stream is less polluted and therefore contains more oxygen.

Q. It is less polluted than the waters of Robbins Reef?

A. Above Washington, yes, when it comes down to the point of the sewage.

Q. How much less?

A. I don't know.

Q. How can you testify, then, if you do not know?

A. Because anybody can see it.

Q. Can you tell how much oxygen there is in water by looking at it?

A. I can tell how much pollution there is by telling how many towns and cities there are.

Q. Is there any other element in the water of the Potomac River that makes it superior in oxygen, so far as you know to Robbins Reef?

A. It is fresh water.

Q. To what extent does that create any superiority?

A. I don't know what percentage, but a certain extent.

Q. Well, give us an idea?

A. I have not any.

Q. Twice as much?

A. No, I should say not.

Q. Well, 50 per cent. more?

A. I do not know.

Q. 20 per cent. more?

A. I don't know.

Q. You don't know anything about it?

A. I don't know very much.

Q. You are testifying as an expert in this case, are you not?

A. I am trying to.

Q. Have you examined the outfall at Washington?

A. I have.

Q. How recently?

A. Last January, I think it was.

Q. You read Mr. Phillip's testimony in this case?

A. Yes.

Q. Do you disagree with him as to his observations of the effects?

A. Not at all.

Q. He is in charge of those works, isn't he?

A. Yes.

Q. What is the treatment given to the sewage of Beverly before it is discharged?

A. No treatment.

Q. None at all?

A. No.

Q. Not even screening?

A. Well, possibly a little screening.

Q. Well, do you know whether it is?

A. No, I do not.

Q. What is the treatment given to the sewage of Salem before it is discharged?

A. I don't think any is given unless it is a coarse screening, which is practically nothing.

Q. Do you know whether it is or not?

A. No, I do not. I suppose that—

Q. I did not ask you to guess; I want to know what you know about it. Why do you compare those outfalls with the proposed outfall at Robbins Reef from the Passaic Valley Trunk sewer?

A. Simply because outfalls of any size which are into salt water are few and I have had to take what I could find.

4147 Q. Ever been abroad?

A. Yes.

Q. Visited the Hamburg works?

A. No.

Q. The Dresden works?

A. No.

Q. The Frankfort works?

A. No.

Q. The Birmingham works?

A. Yes.

Q. When did you visit them?

A. It was 10 years ago.

Q. Where does that discharge?

A. Well, at that time they were using filters; it went on sewage filters.

Q. Do you know that has been abandoned?

A. I believe it has, yes.

Q. Do I understand you to state, in your opinion, the conditions in Boston Harbor are more favorable for digesting sewage and for safe assimilation of sewage than New York Harbor?

A. I think so, very much.

Q. And you have given your reasons?

A. I have tried to, yes.

Q. And the reason why New York Bay is inferior is because of the long trench or fiord, as you called it, reaching from the sea up to about Albany or Troy, is that it, one of the reasons?

A. That is one of the reasons.

Q. Where does the sewage from the Greater City of New York discharge now?

A. All along the shores of Manhattan and Brooklyn.

Q. How many inhabitants are there in the greater City of New York?

A. Did you say the Greater City?

Q. Yes.

A. I believe about five or six millions.

Q. How many are there on the New Jersey shore; how many people?

A. I don't know; I know that the Metropolitan District has perhaps six and a half or so.

Q. Six and a half millions?

A. Yes.

Q. How is this mass of sewage disposed of, if you know?

A. From Manhattan and Brooklyn as I stated, and from New Jersey by similar discharges along the shores.

Q. Right into the waters of the New York Bay?

A. Right into the waters, yes, and Newark Bay.

4148 Q. But, confining your attention now for the purposes of my examination to New York Bay, have you examined the disgusting and odorous conditions which you have described to have been observed by you in Boston Harbor?

A. I have.

Q. Existing in New York Harbor?

A. I have.

Q. Where?

A. Along the shores of New York City.

Q. Anywhere else?

A. In Brooklyn, of course; that is all.

Q. Anywhere else?

A. No, I think not.

Q. Do you find them out in mid-stream in the East River?

A. Yes.

Q. In the mid-stream of the Hudson River?

A. No.

Q. You do not find them there at all, do you?

A. I have not, no.

Q. Have you been across the Hudson River a great many times?

A. Not particularly to study the Jersey side; of course, I have been across many times, but not while looking for these things.

Q. How do you account for the successful disposal of New York City then?

A. I don't think it is very successful.

Q. Are there any epidemics that you know of that have arisen?

A. No.

Q. Any typhoid visitations in New York City from the sewage so far as you have heard?

A. Not that I know of; there may have been though.

Q. Do you know that the health of the City of New York as disclosed recently with reference to typhoid is way beyond the average?

A. Very good, yes.

Q. So much so that they have abandoned the project of filtering the Croton water?

A. I did not know that.

Q. You have not heard that?

A. No.

Q. Well, do you know that they have abandoned the project of filtering the new water supply because of the superior health conditions existing?

A. The last I knew was that they were going to filter it.

Q. Don't you know that they have abandoned it?

A. No, I did not know that. I ought to say, however, in
4149 connection with what I have just said regarding typhoid, that while the rate of New York is creditable with the rest of this country, it is not particularly creditable as compared with the best of other countries.

Q. You have mentioned a typhoid fever case at Deer Island?

A. Yes.

Q. Did that come under your personal observation?

A. No.

Q. Do you know anything, as a matter of fact, of the causes of it?

A. No.

Q. Do you know anything of the history of it from your own knowledge?

A. No.

Q. What do you know?

A. I only know it is said to have come from that sewage.

Q. Did you ever hear the story of the Three Black Crows?

A. I dare say; I don't remember now.

Q. You passed up and down the Hudson River at frequent intervals, haven't you?

A. Occasionally, yes.

Q. Have you ever been injuriously affected by the obnoxious and offensive odors discharged into the Hudson River and Upper New York Bay?

A. Not to my knowledge.

Q. Now, you have been asked to predict the conditions which will arise from the proposed discharge from the Passaic Valley sewer at Robbins Reef; what do you understand the proposed discharge is?

A. You mean in volume?

Q. No, I mean in every respect. Let me hear what the elements are as to which you are predicting consequences?

A. Why, I understand that the sewage from the Passaic Valley is to be collected and held for a time and screened with a good deal of care and then discharged through a tunnel at Robbins Reef.

Q. Is that all?

A. Well, it is to be discharged in a particular way through comparatively small apertures, extending over a large area.

Q. Well, what other elements are there in the problem as it is presented to you to predict as to the consequences?

A. I think that I have stated the important ones.

Q. You don't lay any importance on sedimentation?

4150 A. I said it was to be held. I assume that during holding there would be sedimentation. The only object of holding it is to get sedimentation.

Q. You said it was to be held and screened?

A. Yes.

Q. Do you understand it is to be held and screened or screened and held?

A. I presume it will be screened and held.

Q. And that is what you understand is proposed?

A. That is what I understand is proposed.

Q. Do you understand that it is proposed to produce an effluent from the disposal plant, which when discharged into New York Bay will result in the absence in the New York Bay of visible suspended particles, coming from the Passaic Valley sewer?

A. I am aware that is one of the proposals yes.

Q. Is it an effluent of that character that you are predicting the results of?

A. Naturally it could not be.

Q. Well, then, why do you testify as to the proposed discharge having the effects which you have already stated?

A. Because I do not believe that it can be practicable to produce the condition mentioned by you just now.

Q. In other words, you don't believe that it is proposed to produce an effluent of the character stipulated in this Complainants' Exhibit No. 135, being a stipulation between the United States of America and the State of New Jersey and Passaic Valley Sewerage Commissioners?

A. Of course, I understand that that is proposed, and if I believed that that could be done and that would really in effect be what would happen, I could have no objection, of course.

Q. Well, do you doubt that that is what is proposed to be done?

A. No, I do not doubt it is proposed by New Jersey.

Q. Then why do you say that the proposed discharge will result as you have testified?

A. Because I do not believe that the thing proposed can be carried out.

4151 Q. Well, do you wish to modify your testimony?

A. No.

Q. You still wish to say that the discharge as proposed will result as you have testified?

A. I think so, yes.

Q. Notwithstanding the fact that the proposal is to produce an effluent from which there will be an absence in New York Bay of visible suspended particles, of sewage?

A. Notwithstanding that, yes.

Q. Do you understand that it is proposed to produce effluent which when discharged into New York Bay at Robbins Reef will result in an absence of deposits objectionable to the Secretary of War of the United States, in the New York Bay, coming from the Passaic Valley sewage?

Mr. O'Sullivan: I object to that question; it calls for a psychological determination by this witness, which he has not qualified himself to give.

The Commissioner: Note the objection of Counsel for the Complainants.

A. I do understand that; yes, sir.

Q. And notwithstanding that you say that in your opinion the proposed discharge will result in the consequences which you testified to in your direct examination?

A. I do.

Q. Well, Professor, will you please define "proposed" as you are using it in your testimony?

A. Why, I understand by the "proposed" scheme as it is taken in a larger sense by engineers. There are many limitations to the word "proposed"; one man has one idea in his mind, and another man has another. I understand by proposed a scheme which will take the sewage and pour it out as I have said; and what another man or set of men may mean by it, I cannot say.

Q. Well, when you use the word "proposed" in connection with the discharge from the Passaic Valley Sewer, you use it, do you not, in direct disbelief of the effluent which will result as specified and agreed in the stipulation in question?

A. I do.

4152 Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Professor Sedgwick, in what condition would you expect the Passaic Valley sewage to reach the Newark Meadows after several pumpings, and after many hours in transit?

Mr. Riker: The question is objected to on the ground that it is not redirect examination of any examination on the cross.

The Commissioner: Note the objection.

A. I should expect it to arrive finely divided and already freed from heavier suspended particles, such as sand and things having high specific gravity, but passing very rapidly through screens. This is in fact the way in which the sewage arrives at the Nutt Island, very little being held back by the screens.

Q. Will the great mass of that sewage pass through a screen 4/10ths of an inch in mesh?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. It certainly will.

Q. What condition would you expect the sewage to be in as to septicity when it reached the sedimentation tanks?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. In summer I should expect it to be destitute of oxygen and often in a stinking, rotten condition, a condition commonly described as distinctly septic.

Q. Those finely divided suspended particles that you described in your previous answer, are they particularly putrescible?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. Some of them are, because attached to them are frequently clusters of bacteria, feeding upon the organic matters. Some of them are not particularly so.

Q. Are they readily sedimentable?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Not very, no; they float pretty readily.

Q. Professor Sedgwick, handing you Complainants' Exhibit No. 135, I ask you if the plant described in that exhibit will produce the effluent or rather the effects guaranteed from the effluent as stipulated for in that exhibit?

A. I don't believe that they would.

Q. In reply to a question put to you by Mr. Riker relative to the typhoid fever case which you mentioned as occurring to the light house tender in Boston Harbor, I ask you if you have any direct knowledge of other typhoid cases directly traced to manipulating the sewage at that outfall?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I have. Two of my students, in doing a piece of work upon Boston sewage together for investigation, came down with typhoid fever and careful investigation seemed to exclude all other known causes than the sewage upon which they were working. I therefore was forced to believe that they contracted the fever from the sewage.

Q. What were the names of those two students?

A. Mr. Saville, now a partner of Mr. Rudolph Herring and Mr. Greeley now Assistant Chief of the Sewage Experiment Station in Chicago.

Q. Contributing to the pollution of New York's Upper Bay, what riparian cities in the State of New Jersey are there?

A. I am not sure that I know them all, but of course, Jersey City, Hoboken and whatever cities, if any, between them, and the state line.

Q. Is the oxygen content of fresh or brackish water higher?

A. Of fresh water.

4154 Q. Is the sewage digestive capacity of fresh or brackish water highest?

A. Fresh water is higher in digestive capacity.

Q. Is the Potomac River a large or a small river?

A. Very large river.

Q. How is it as to salinity?

A. It is fresh at the point of disposal of the Washington sewage.

Q. Is the current swift enough to take whatever sewage is discharged into it, some considerable distance before depositing it?

A. Generally so, although that of course depends on the tide and upon the flood conditions in the river.

Mr. O'Sullivan: That is all.

Cross-examination by Mr. Riker:

Q. What do you know about the rapidity of the Potomac River; how fast does it run?

A. Well, of course at the sewage station, it may stand still.

Q. I did not ask you that; I asked you what is the flow of the Potomac River?

A. I will say then that I do not know.

Q. Is it possible to produce an effluent from the sewage of the Passaic Valley District, which will result as guaranteed in the stipulation which is Complainants' Exhibit No. 135 in your opinion?

A. I think so.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Has such an effluent ever been produced by the treatment of septic sewage anywhere in the world, that you ever knew of, Professor Sedgwick?

A. I did not understand the question to be purity at Robbins Reef under this system. I understood Mr. Riker's question to mean whether it was possible to so purify the sewage coming from the Passaic Valley as to fulfill the conditions mentioned in the stipulation. I do not see any practicable way of purifying the sewage at Robbins Reef except at extraordinary expense and under enormous difficulties, both physical and chemical, and I do not know of any city or town which produces and then purifies a sewage so septic as I believe this would be when it arrives at Robbins Reef.

Q. Is it an advantage or a disadvantage to treat sewage near the source of its origin?

A. Generally speaking, a great advantage.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. Repeat the answer, Professor: in your opinion is it possible to treat the sewage of the Passaic Valley in such a way as results in an effluent which will result as guaranteed in the stipulation?

A. Yes, I think it is.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Would you say whether or not the expense attending the production of such an effluent as stipulated for here in Complainants' Exhibit No. 135, would be prohibitive or not, in price or cost?

Mr. Riker: The question is objected to on the ground that it does not deal with the issue in this case; the complainants in this case having no possible concern with the expense.

The Commissioner: Note the objection of Counsel for the Defendants.

Mr. O'Sullivan: The question is pressed by Complainants' Counsel for the reason that it has been testified to by this witness that it is not feasible to produce an effluent stipulated for or the results guaranteed in Complainants' Exhibit No. 135, and that as there is a provision in the second paragraph "Or other requisite, lawful additional arrangements" the question is pressed for the purpose of determining whether or not such additional arrangements may or may not be prohibitive and unlawful on the item of expense.

A. I wish to state in order to be perfectly clear, that I do believe it perfectly possible to purify the Passaic Valley sewage in 4156 - such a way that the effluent could be put into New York Harbor or anywhere else and produce no harm; but I do not believe that it could be done by the scheme referred to which discharges at Robbins Reef. I believe it would have to be done either on the Newark Meadows or Newark Bay or somewhere; and of course at a very great expense. I do not believe that that would be prohibitive; I believe it would be very large. I believe that cities and towns are going to purify their sewage even at very great expense in the future, and in order to be still clearer if I can, I mean to say that I believe that to purify the sewage, which it is now proposed to bring to Robbins Reef under the stipulation referred to, either at that point, or at some neighboring point on the shores of New York Bay, would not be practicable. I do believe it would be practicable to purify it in Newark Bay, taking it before it gets septic and having filter beds there, and that is what I believe ought to be done. I am not sure that I answered your question.

Mr. O'Sullivan: That is all.

Redirect examination by Mr. Riker:

Q. Well, Professor, don't you understand that the purification plant is located at the Newark Meadows adjoining the Newark Bay?

A. I understand that the sedimentation and screening plant is,

Q. The purification works that are contemplated:

A. So far as contemplated, yes.

Q. On the Newark Meadows; at about the point you indicated?

A. I should say so, yes.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Are those purification plants consisting of sedimentation and screening sufficient for the purification of the sewage?

A. Not in my opinion.

Mr. O'Sullivan: That is all.

4157 Recross-examination by Mr. Riker:

Q. You think there might be added some filter beds to advantage?

A. Filter beds or other appliances, yes.

Mr. Riker: That is all.

Mr. O'Sullivan: That is all.

Adjourned to June 17th, 1913 at 10:30 a. m.

Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COM-
MISSIONERS, Defendants.

Before James D. Maher, Commissioner.

NEW YORK CITY, June 24th, 1913—10:30 a. m.

Appearances:

William P. O'Sullivan, Esq., Special Counsel for the People of the State of New York, Complainants;

Adrian Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

4158 EDWARD ELLERY, a witness in behalf of the Complainants, re-called in rebuttal, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Professor?

A. Edward Ellery.

Q. Did you testify in this case previously?

A. I have.

Q. Professor Ellery, have you read the testimony given by Mr. George A. Johnson, a witness called by the Defendants in this suit?

A. Yes, and with particular reference to that part of his testimony that relates to a certain dye experiment performed by him, November 19, 1907.

Q. Will you state what you noted especially in that part of his testimony relating to the dye experiment?

A. I noted:—

1. The dye used was so called red R dye.

2. The strength of the dye solution was a little more than 1 part in 12,500.

3. The direction of the discharge of the solution was vertically downward.

4. The direction of the current on the surface and on the bottom at the time of the discharge into the 30 foot depth was the same and the velocity was the same.

5. At the time of the discharge into the 40 foot depth, the current at the surface was of greater velocity than at the bottom but in the same direction.

6. The maximum of sewage discharge in the proposed plan is to be 360,000,000 gallons per day.

7. The salinity of the water at the time of the discharge of the dye solution was 8500 parts chlorin per million.

8. A quotation is made from the report of the Metropolitan Sewerage Commission for 1910, pages 457 to 460, relative to results of a certain dye experiment performed by the Commission.

4159 9. A quotation is made from a report of the U. S. Coast Survey for 1873, page 129, relative to tidal velocities off Robbins Reef, showing mean surface velocity of flood tide to be 0.35 feet per second, average minimum velocity of flood tide at all depths 0.29 feet per second, and average minimum velocity of ebb tide at all depths 0.52 feet per second.

10. A quotation is made from the report of the Metropolitan Sewerage Commission for 1910, page 155, relative to tide velocities.

11. Mr. Johnson states that tide velocities have not changed to his knowledge between 1892 and 1907.

12. Mr. Johnson draws an inference on the result of one dye experiment that fresh water sewage discharged as proposed through outlets, some 150 in number and located at a depth of 40 feet or more below the surface will undergo sufficient complete diffusion in the waters of New York Bay so as not to raise to the surface in objectionable quantities if at all, and rarely if at all in visible quantities.

Q. Will you state fully what studies and investigations of a scientific character you have submitted these enumerated items of Mr. Johnson's testimony to, Professor?

Mr. Riker: The question is objected to as not being rebuttal.

The Commissioner: Note the objection of Counsel for the Defendants.

A. The dye solution was less than $\frac{1}{2}$ as strong as the weakest dye solution used by the Metropolitan Sewerage Commission in its dye experiments. Mr. Johnson's solution was 1 part to 12,500. The weakest solution of the Metropolitan Sewerage Commission was that of Special Scarlet, a dye in every way similar to the so called Red R dye, its solution was 1 to 5000 parts.

4160 1. The testimony of Dr. Soper, given in this case at pages 4276 and 4279 shows that the dye used by the Commission for its deep water experiments was uranin, a dye that is very much more persistent, that is, it is visible in far greater dilution than either

Special Scarlet or the so called Red R dye. It is visible in a dilution of 1 part to 30,000,000 parts.

2. Mr. Johnson gives no data to show whether the water at the points of discharge was of different degrees of salinity at different depths.

3. Reference to the place in the report of the Metropolitan Sewerage Commission for 1910, at page 155, where current velocities are given, from which Mr. Johnson quotes, shows that no velocities are given for the current off Robbins Reef.

4. Without further data than are given in his testimony, Mr. Johnson's opinion as to what will happen when fresh water is discharged into salt water is unreliable and his conclusion is erroneous.

Q. Will you give the facts supporting your statement that Mr. Johnson has given insufficient basis for his conclusions from his dye experiment and that his opinion is erroneous, Professor?

A. The grounds for these statements are experimental studies I have made on the effect of salinity and direction of discharge on the ascent of fresh water in salt water. These experimental studies consisted of discharging fresh water, made with a solution of dye in the same strength as that used by Mr. Johnson in his experiments, in salt water of varying degrees of salinity, and discharging that fresh water in different directions, downward, laterally and upward. The report that I make on those experimental studies includes series of photographs showing the effect of direction of discharge on the ascent of the fresh water in the salt water and also the effect of different degrees of salinity in different depths. The report includes
4161 a photograph showing the effect of discharging a dyed fresh water in an upward direction in salt water of the same degree of salinity as that which Mr. Johnson states existed in the water at the time of his experiments. The report describes the way in which these experiments were performed, the salinity of the waters, the apparatus used, and the results of the different series of experiments. The series of experiments were:

1. Effect of direction of discharge of fresh water into salt water when the latter is of the same degree of salinity throughout;

2. The effect of delivering fresh water in an upward direction into salt water, consisting of layers of different degrees of salinity; and

3. The effect of delivering fresh water in a downward direction into salt water consisting of layers of different degrees of salinity. The results of each series are tabulated and the conclusions from each series are given at the end of the description of the individual series, and at the end general conclusions from all the series and from the experimental studies, in general.

Q. Who conducted these experimental studies?

A. I did.

Q. Who prepared the report that you have just described?

A. I did.

Mr. O'Sullivan: I offer the report just described by this witness in evidence, and ask that it be marked Complainant's exhibit No. 216.

Mr. Riker: The offer is objected to on the ground that the report is not proper evidence, is immaterial, irrelevant, and not rebuttal.

The Commissioner: Note the objection of Counsel for the Defendants.

Received in evidence and marked Complainants' exhibit No. 215.

Q. Will you state what conclusions you reached from you experimental studies on the effect of salinity, and direction of discharge on the ascent of fresh water in salt water?

Mr. Riker: The question is objected to as not being rebuttal of any evidence of the Defendants.

The Commissioner: Note the objection of Counsel for the Defendants.

4162 A. 1. If the salt water is of the same degree of salinity throughout its depth, fresh water delivered into it at the bottom will come to the surface whatever the direction of discharge.

2. A slight difference in salinity at different depths is sufficient to prevent fresh water from rising to the surface when it is delivered in downward direction in the lower stratum.

3. The conditions which will prevent fresh water from rising to the surface when delivered in the lower stratum in a downward direction will not prevent the fresh water from rising to the surface when delivered in the lower layer in an upward direction.

4. Therefore, what happens when fresh water is discharged in downward direction in lower layers of salt water is not a criterion of what will happen when the same fresh water is delivered in the same layer in an upward direction.

Q. Will you apply these conclusions to the conditions of salinity of the water off Robbins Reef?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

A. The report of the Metropolitan Sewerage Commission for 1910, page 527, contains a table and subjoined statements showing the salinity at Robbins Reef at different depths.

Date, 1909.	Time.	Surface.	Per cent. land water.	
			20 ft. depth.	40 ft. depth.
August 23.	10:45 A. M.	40	36	28
	12 M.	34	30	24
	1:15 P. M.	34	26	24
	2:00	32	28	26
	3:00	34	24	24
	3:30	28	26	26
	4:15	32	24	20
Sept. 1.	11:00 A. M.	20	16	16
	12 M.	24	20	20
	1:00	26	22	22
	2:00	22	24	22
	3:15	24	26	24
	4:15	28	26	26

There is a quotation from that report joined to the table as follows:

"The difference between the salinity of the water at the surface and at a depth below the surface of 40 feet was found more marked at Robbins Reef than in most other places. * * * but this condition was variable. A sample taken at Robbins Reef October 30, at 4 P. M. had a specific gravity of 1.025 indicating an entire absence of land water."

There is a further quotation, as follows:

"The amount of land water (December, 1909), at slack high water varied from 14 to 32.4 per cent, and at slack low water from 12 to 36.4 per cent."

From this table and these quotations in the light of my experimental studies the inference may be drawn, that:

1. If fresh water were delivered in downward direction in the lower layer of water off Robbins Reef at any time August 23, 1909, between 10:45 A. M., and 4:15 P. M., it would not have come to the surface.

While if it were discharged in an upward direction in the 4164 lower layer at any hour except the first, namely 10:45 A. M., it would have come to the surface. And it might also have come to the surface at the other, the first period, depending on the velocity of the discharge.

2. If fresh water were delivered in downward direction in the lower layer of water off Robbins Reef at any time between 11:00 A. M. and 4:15 P. M., on September 1, 1909, it would not have come to the surface.

3. If fresh water were delivered in any direction, downward, sidewise, or upward, in the lower layer of water off Robbins Reef, at 4 P. M. October 30, it would have come to the surface.

Q. Professor, are the conclusions reached from your experimental studies supported by other evidence?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The report of the Metropolitan Sewerage Commission for 1910, page 460, states, regarding the results of its dye experiments:

"In 29 cases out of 66, the sewage came at once to the surface; in 31 cases no effect was visible; in 6 cases the result was doubtful."

It is evident from these results that there are conditions which at times prevent the dye solutions discharged in downward direction in the lower layers from coming to the surface. It is further evident from these results that the inference that fresh water sewage discharged as proposed through outlets, some 150 in number and located at a depth of 40 feet or more below the surface, will undergo sufficient diffusion in the waters of New York Bay so as not to raise to the surface in objectionable quantities if at all, and rarely, if at all, in visible quantities, is erroneous.

Q. Have you any further evidence that supports the conclusions reached from your experimental studies?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

4165 A. In his testimony, pages 4276 to 4279, Dr. Soper gives the details of some of the dye experiments of the Metropolitan Sewerage Commission.

The experiments of dates June 15, July 30, July 31, August 2nd and August 3, 1909, give no details as to salinity.

The experiments of August 5, 6, and 13 give salinity determinations, but in these instances, the fresh water was delivered at different depths.

August 11, fresh water dye solution discharged at 35 feet, the salt water showing three distinct layers of different salinity, no color appeared on the surface.

August 18, fresh water dye solution discharged at 30 feet, the salt water showing two distinct layers of different salinity, no color appeared on the surface.

August 26, fresh water dye solution discharged at 44 feet to 36 feet, the salt water showing three distinct layers of different salinity, no color appeared on the surface.

Q. Do the experimental studies on the effect of salinity and the direction of discharge on the ascent of fresh water dye solutions in salt water enable you to state what will happen when fresh water is discharged upward and reaches the surface?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. In general it may be stated that in all cases in which the dye solution rose to the surface that the tendency of the fresh water was to come to the surface in an ever enlarging column from the orifice. Then a very slow diffusion downward began. In two hours it moved only a few inches in the downward direction. When it came to the surface after downward discharge in the lower layers it did so in an irregular shaped mass, approaching the shape of the cylinder. Except for the restraining walls of the containing vessel, it would have spread over a larger surface, for there is no reason why it should not move horizontally as well as in a vertical direction downward.

4166 Q. Have you made any other study to show what would be the effect of discharging a large mass of sewage into salt water such as proposed by the Passaic Valley Sewerage Commissioners?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I have made experimental studies on the aeration of water from the atmosphere to show what would be the effect of sewage pollution on such aeration, and I have a report of that series of studies entitled "The aeration of water," with a special topic "The influence of sewage pollution." This report contains first a photograph of the apparatus that was used for the studies, which consisted of two large elliptical tanks built one over the other, and containing each over 3,000 gallons of water. The object of the two tanks was to enable us to have two waters under exactly the same atmospheric

conditions and I wanted to get as large a volume of water as was possible, and that accounts for the size of the tanks. The report also gives a diagram of the tanks, with a drawing showing the apparatus devised for maintaining the water in motion. Each tank was provided with a wing with shutters which opened and shut so that at a forward movement, the water was pushed ahead in a backward movement the shutters were opened and the water was not moved in the backward direction. The report describes the method of operation for filling the tanks with water, and for boiling the water to drive off the oxygen; we had especially constructed steam connections with the tanks to boil the water. The report also states that the sewage was used from the sewers and that was collected by myself. The report also shows the methods used for examining the amount of dissolved oxygen and gives a description of the reagents that were used. It gives an outline of the plan of observation. First, a study of salt and fresh quiescent waters; second a study of polluted and unpolluted quiescent salt water with varying degrees of pollution; Third, a study of polluted and unpolluted moving salt
4167 water with varying degrees of pollution. A series of observations were made for each one of these outlines, and at the same time that oxygen determinations were made, measurements of humidity, barometer measurements, the temperature of the air and the temperature of the water were made, and the report includes the tables showing the figures as well as the time of day and the day of the week at which the work was done; and in the case of the salt waters showing the salinity of the water, and in the case of polluted waters giving the dilution of sewage in the water. The report also contains some diagrams or curves showing the amount of oxygen contents at the various periods of sampling the water. The report shows the conclusions from each series of determinations, and the conclusions are summarized at the beginning of the report rather than at the close.

Q. Who did the experimental work, and made the experimental studies that are embodied in that report?

A. The experimental work was all done under my immediate supervision and direction.

Q. Who prepared the report?

A. I did.

Mr. O'Sullivan: I offer that report, described by this witness in evidence, and ask that it be marked Complainants exhibit No. 217.

Mr. Riker: I want to ask some questions on that.

Cross-examination by Mr. Riker:

Q. Who did the actual experimental work, Professor Ellery?

A. The actual experimental work was done by my assistant, Mr. A. J. Salathe.

Q. Where is he?

A. In Schenectady.

Q. Not sick, is he?

A. That I cannot answer, sir.

Q. You don't know anything about him now?

A. Not now.

Q. When did you last see him?

A. I think about 10 days ago.

Q. Do you know anything about the truth or falsity of the statements that he has furnished to you as the result of his experiments of your own knowledge?

A. I know they are true.

4168 Q. How do you know they are true?

A. Because I was present when he did his work, and made his calculations.

Q. All of it?

A. Yes sir.

Q. Then it is your work, isn't it?

A. No sir.

Q. You checked it all up?

A. Yes sir.

Q. You took part in the experiments?

A. I was present when they were being done.

Q. Did you watch him while he was making the experiments?

A. Yes sir.

Q. Then you know of your own knowledge that they are correct, do you?

A. Yes sir.

Q. Did you write out this report (indicating)?

A. Yes sir.

Q. How does it differ from the testimony that you are reading from your typewritten copy that you have before you?

A. It does not differ at all.

Mr. Riker: I object to it, on the ground that it is not properly proved, it is not evidence, not rebuttal, and is immaterial, and irrelevant.

The Commissioner: Note the objection of Counsel for the Defendants.

Received in evidence and marked Complainants exhibit No. 216.

Direct examination by Mr. O'Sullivan (resumed):

Q. Will you state what conclusions your experimental studies as embodied in Complainants exhibit No. 217 relating to the influence of pollution on aeration enabled you to reach?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. 1. The rate of absorption of oxygen from the atmosphere by quiescent or slowly moving water seems to be about the same for fresh water as for salt. Whatever effects the rate of absorption seems to effect both fresh and salt water alike.

2. The humidity of the atmosphere affects the rate of absorption, the greater the humidity, the less the absorption.

4169 Hence the most favorable condition for the aeration of water from the atmosphere will be a low percentage of humidity.

3. Under these favorable conditions, a permissible dilution of sewage in quiescent or slowly moving water, water moving less than 1 foot per second, is 1 to 100, that is 1 gallon of sewage to 100 gallons of water, while a dilution of 1 to 60 is not permissible. That is to say, a dilution of 1 to 60 will reduce the oxygen content, while a dilution of 1 to 100 does not materially reduce the oxygen content.

Q. Will you apply these conditions to the conditions found in the vicinity of Robbins Reef Light?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Under the Passaic Valley Sewerage Commission's proposed plan the sewage is to be delivered in an upward direction, as I understand the plan, from 150 openings at a depth of 40 feet or more. With that direction of discharge, it will rise to the surface under the conditions of salinity shown to exist at that point. With the low maximum and minimum and mean current velocities at flood tide which Mr. Johnson testified to, this sewage would require a dilution in the proportion of 1 to 100, whether it were to mix with salty or fresh water, if the oxygen content of the water were not to be reduced, and further, if the water were unpolluted and contained at least 70% of the saturation value of oxygen. If the maximum flow of sewage in the proposed plan is to be 360,000,000 gallons per day, it would have to mix with 36,000,000,000 gallons of unpolluted water to secure the proper dilution, or approximately 4,800,000,000 cubic feet. If the sewage mixed with this quantity of water came to the surface in the shape of a perfect cone with apex at the orifice of discharge 40 feet below the surface, the area covered at the surface would have a diameter of approximately 4 miles.

4170 But the sewage won't come to the surface in the shape of a perfect cone, owing to the resistance of the water and to the interference with each other of the discharges from the different jets. It is more likely to come to the surface directly over the orifice and then spread out over the surface in a layer of increasing thickness, depending on the rapidity of diffusion in a downward direction, a diffusion which is very slow. If the layer is 10 feet thick, its area at the surface would have a diameter of 4.6 miles, if the sewage is to have the proper dilution; if the layer is 20 feet thick the surface area would have a diameter of 2.8 miles.

Of course it is understood that all this 360,000,000 gallons of sewage is not coming out at once, but is the maximum discharge for the day. If one-fourth were discharged every tidal period, the diameter of these surface areas would be divided by four for every such period. But it is to be remembered that this water into which it is proposed to discharge this amount of sewage is already carrying its burdens of sewage, and is never completely refreshed. Only 20 per cent of the water coming in at the Narrows can have a refreshing action, the other 80 per cent being water that has already been in the Harbor and is polluted. That means that in these waters a dilution of 1 gallon of sewage to 500 gallons of water is the permissible limit, or in other words, that the surface area over which the sewage is to be spread if it is to be properly diluted will be five

times as large. If the smallest of these areas is taken, namely that of 2.8 mile, or 0.7 mile per tidal period, that means the sewage discharged in such a period and coming to the surface must move on the surface before its diffusion 3.5 miles in six hours. My belief and opinion is that it won't have sufficient velocity to move that distance in the time, but rather it will remain in a mass near the point of discharge on the surface, or be carried in a mass by the tidal currents oscillating back and forth in the Harbor. In the light of these facts, it seems to me that the introduction of 360,000,-
 4171 000 gallons of sewage into the already polluted waters of the Upper Bay of New York will produce an intolerable nuisance condition, resulting from a further depletion of the already reduced oxygen content of the waters of the Bay.

Mr. O'Sullivan: He is your witness, Mr. Riker.

Cross-examination by Mr. Riker:

Q. Professor, you spoke of the proposed discharge of the Passaic Valley Sewer. Where did you get your information as to the proposed discharge of the Passaic Valley Sewer?

(Witness examines papers.)

Q. Can't you answer that without looking at your notes?

A. I am going to tell you exactly where it is; I am looking over Mr. Johnson's testimony.

Q. Well, is it from Mr. Johnson's testimony you got your information?

A. Yes sir.

Q. Have you examined Complainants' exhibit No. 135 which I hand to you (handing witness paper)?

A. I looked this over about two years ago.

Q. Well, look it over again. Do you recognize that as containing a statement of the proposed discharge?

A. I don't put my eye on it here.

Q. Well, take the time to read it through then, and get your eye on it, and see if you recognize that as the proposed discharge of the Passaic Valley Sewer?

A. I read here on page 3 that there will be a series of not less than 150 Tees of a diameter not exceeding 1 foot, and spaces approximately 10 feet apart.

Q. My question is whether you recognize that as the description of the proposed Passaic Valley Sewer?

A. I can't answer that question, Mr. Riker.

Q. Does that describe the discharge upon which you are testifying as the proposed discharge of the Passaic Valley Sewer?

A. I can't answer that.

Q. Why can't you answer that?

A. Because I am not an engineer. I am a chemist, and I am basing my present testimony on a statement contained in the
 4172 testimony given by Mr. George A. Johnson with reference to the discharge.

Q. You used the words, however, in your testimony, that the proposed discharge of the Passaic Valley Sewer would have certain definite results?

A. That is a quotation from Mr. Johnson's testimony.

Q. You are quite sure about that, are you?

A. I will read it to you.

Q. I don't want you to read the quotation. My recollection is that you testified on your own evidence that the proposed discharge would have certain results upon the oxygen of the water?

A. In his testimony—

Q. Well, did you or did you not testify, or don't you know whether you testified to that effect?

A. I testified about the proposed discharge, but the words "proposed discharge" are quoted from Mr. Johnson's testimony.

Q. Then you are not testifying of your own knowledge as to the proposed discharge of the Passaic Valley Sewer?

A. I am testifying from Mr. Johnson's testimony.

Q. Is that all you are testifying from?

A. I am taking from Mr. Johnson's testimony, and testifying from that.

Q. Is that all you are testifying from as to the proposed discharge of the Passaic Valley Sewer?

A. In the present instance, yes.

Q. Well, now, what is your business?

A. I am a chemist.

Q. A scientific gentleman?

A. I am a chemist.

Q. A scientific gentleman, are you?

A. I am a chemist.

Q. Are you in the habit of neglecting important data in your work as a chemist?

A. If Mr. Johnson's data are unimportant, then I am.

Q. When you attempt to testify as to the results of the proposed discharge of sewage, do you mean to say that you do not even examine the statement of what is proposed to be done?

A. It seems to me that Mr. Johnson's testimony is sufficient.

Q. Is a sufficient statement of the proposed discharge in your opinion, is it?

A. He is a reputable engineer, and one of your own witnesses.

4173 Q. I draw your attention to Complainants' exhibit No. 135, which was put in on behalf of the people who are retaining and paying you, purporting to be a stipulation between the United States of America and the State of New Jersey, and the Passaic Valley Sewerage Commissioners, stating what will be the results of the discharge of this sewer at Robbins Reef. Have you examined it?

A. I read that over, several years ago.

Q. Would you recognize that as a statement of the proposed discharge, or wouldn't you?

A. I recognize that this stipulation or contract gives an agreement between the United States and the Passaic Valley Sewerage Commissioners as to the character of the material discharged at the office at Robbins Reef.

Q. Does that differ in any way from stating that that is a statement of the proposed discharge from the Passaic Valley Sewer?

A. I want to make it very clear what I am testifying to today is from statements made by Mr. Johnson in his testimony.

Q. What I want to have made very clear is whether you identify those statements with Complainants' exhibit No. 135 as the proposed discharge of sewage?

A. That, Mr. Riker, it seems to me to be entirely outside my testimony. If Mr. Johnson's testimony is incorrect, if it does not agree with the stipulation made by the United States with the Passaic Valley Sewerage Commission, then that is Mr. Johnson's error, and he is one of your witnesses.

Q. You are not making an argument?

A. It is not my error at all. I was called upon to make answer to certain statements made by Mr. Johnson in his testimony. I have done so.

Q. Do you recognize the statement of the proposed discharge as given by Mr. Johnson to differ in any respect with the statement made in Complainants' exhibit No. 135?

A. I am not engineer enough to answer that question.

Q. But you are engineer enough to know as to the results of the discharge as described by Mr. Johnson, are you?

A. I am chemist enough.

Q. You are chemist enough?

A. To know what will happen in a discharge as described by Mr. Johnson of 360,000,000 gallons of sewage per day into salt water.

Q. What was that sewage that Mr. Johnson described to be discharged?

A. He stated that the maximum discharge was 360,000,000 gallons a day.

Q. What kind of sewage?

A. He doesn't state.

Q. Does it make any difference what kind of sewage was to be discharged?

A. If the sewage had been oxidized before being discharged it certainly would make a good deal of difference in the effect on the oxygen content of the water.

Q. It would make a great difference whether it was crude sewage or treated sewage, wouldn't it?

A. Yes sir, on the effect of it on the oxygen content of the water.

Q. Now, which was Mr. Johnson testifying to?

A. Mr. Johnson states that the discharge will be 360,000,000 gallons sewage per day.

Q. What kind of sewage did he say it would be, treated, or untreated?

A. He does not state.

Q. You are sure of that?

A. In that place I am quoting.

Q. In that sentence you are quoting he does not state it?

A. In that testimony with reference to the discharge he does not state.

Q. Have you read all Mr. Johnson's testimony?

A. I think I have.

Q. Don't you know that he testified directly upon Complainants' exhibit No. 135?

A. I do not.

Q. Now, you said that you understood that the discharge would be vertical. Where did you get that understanding from?

A. That I got from my understanding of this contract, and from my various talks with engineers who are conversant with the proposed plan.

Q. You say you get it from this contract, do you?

A. That is my impression, but it has been two years since I read that, and I am not enough of an engineer, as I say, to interpret it anyway; but there are other engineers who are reputable and whom I can quote who have so described that discharge.

Q. I will read to you from the stipulation, at the end of the main paragraph, paragraph first, of the stipulation. (Reading) "On each of these vertical tees shall be placed outlets arranged to discharge horizontally across the tidal current." Do you understand horizontally to mean vertically?

A. No sir.

Q. Well, then if that is the proposed discharge, you are in error in your testimony, aren't you?

A. Not altogether, not sir.

Q. Why aren't you?

A. Because a sewage discharged downward will produce quite a different effect from sewage discharged horizontally or upward.

Q. But when you say that you understand that the sewage is to be discharged upward you are mistaken, aren't you?

A. Yes, I am mistaken with reference to that.

Q. Well, why did you testify on a matter of some importance without having found out what the proposed discharge was to be?

A. I am testifying on the authority of reputable engineers who know the plan.

Q. You had this stipulation before you at one time, did you not?

A. Several years ago, but not as an engineer, Mr. Riker.

Q. I asked you whether you had it before you?

A. Two years ago.

Q. And you knew it contained a contract stating the proposed discharge, did you not?

A. Yes.

Q. Why didn't you refresh your memory when you undertook to testify as to what the proposed discharge was?

A. Because the experiment of your witness, Mr. Johnson, discharged the sewage downward and the effect of discharging sewage

downward is quite different from discharging it in other directions. It makes very little difference if the sewage is not to be discharged downward; it makes a good deal of difference when you are drawing a conclusion from the effect of discharging sewage downward as to what will be the effect when the sewage is discharged in any other direction.

Q. But what I want to know is, when you undertook to state the proposed plan of the Passaic Valley Sewerage Commissioners, why you did not refer to the authoritative statements of it contained in this stipulation?

A. Your witness is an authority and I did not think it was necessary to go any farther than the statements of your witness.

Q. You mean to say our witness Mr. Johnson says that this discharge is vertical?

A. I did not.

Q. Well, I am asking you why when you undertook to testify as to the proposed direction of discharge you did not consult the authoritative document which is put in by your own counsel?

A. What I have done is to take the statement of reputable engineers with reference to that discharge. My impression has been from these reputable engineers that that discharge was not to take place in a downward direction. Your witness made an experiment discharging that sewage in a downward direction; my argument is that what takes place when sewage is discharged in a downward direction is not a criterion of what will take place when it is discharged in any other direction.

Q. Yes, but confine your attention to the part of your testimony where you say you understand the discharge is to be vertical?

A. Yes.

Q. Now, what reputable engineers told you that that was to be the discharge?

A. Well, I got that from several.

Q. Well, who are they?

A. Professor Olin H. Landreth of Union College; another is Professor Phelps of the Massachusetts Institute of Technology.

Q. Who else?

A. I don't recall any others just now.

Q. And they told you that the discharge was to be vertical, did they?

A. As I recall it, yes sir.

Q. You recognize that the proposed discharge is not to be vertical, do you not?

(Counsel hands witness Complainants' exhibit No. 135.)

A. I note that it states in this stipulation that the discharge is to be horizontally across the tidal current.

Q. Have you any doubt as to that being what is proposed to be done?

A. No sir.

Q. Then, you are mistaken in your understanding, are you not?

A. I am mistaken in my understanding as to the direction of

discharge; I am not mistaken in my understanding as to what will take place when sewage is discharged downward, and as to what will take place when it is discharged in any other direction.

Q. I did not ask you that; I asked you whether you are mistaken as to the direction of the discharge proposed?

A. I answered yes.

Q. Now, the dye experiments conducted by Mr. Johnson, to which you have directed your testimony at length consisted of the use of what dye?

A. What he called Red R dye.

Q. Have you any doubt that he calls it correctly?

A. I have.

Q. What should it be called, in your opinion?

A. — Red R dye.

Q. Why?

A. Because there is not any Red R dye on the market.

Q. Then, if there is another Red R dye in the market, you think the addition of 2 makes any difference?

A. Makes a great deal of difference.

Q. Then you think he used 2R, do you, instead of one R?

A. I think so.

Q. Do you know?

A. I don't know anything about it.

Q. Do you doubt it?

A. I know he did not use Red R dye.

Q. Do you doubt that he used R dye?

A. I have not any knowledge.

Q. I asked you whether you knew?

A. I have no knowledge, sir.

Q. Do you doubt that the results of the experiment as described by him were correctly observed?

A. Not at all.

Q. And that he did not find traces of the Red R dye on the surface?

A. Not at all.

Q. And that there were in fact no indications of the Red R dye in the water?

4178 A. I don't doubt that testimony at all.

Q. You don't doubt that his observations were correctly made and correctly represent the facts, do you?

A. I don't doubt that at all.

Q. How does the solution of the Red R dye in the proportions that he describes compare, so far as its visibility is concerned, with the proposed discharge from the Passaic Valley Sewer?

A. It might have come to the surface, and being so weak a solution the color would not be visible to him. A solution of that dye, 1 to 12,000, is a very thin solution.

Q. Taking and comparing it with the proposed discharge from the Passaic Valley sewer before it is diffused in any water which would be more marked and striking?

A. What are you comparing, Mr. Riker?

Q. I am comparing the solution of the Red R dye which you describe with the sewage as you understand it is proposed to be discharged at Robbins Reef from the Passaic Valley Sewer?

A. I think you cannot make any inference whatever from his experiment, because he delivered his dye down rather than in a sidewise direction or up.

Q. Will you make a comparison of the two as you understand them, the Red R dye solution, and the sewage as discharged at Robbins Reef?

A. I cannot make any comparisons.

Q. Why not?

A. Because the direction of the discharge is not the same.

Q. Take it before it is discharged: I want you to take the two things and compare them, that is what I am asking you to do. Which is the more visible and more marked, the more striking, the Red R solution or the sewage?

A. In the strength of solution that Mr. Johnson used, I do not know that you could say that the dye solution would be more marked than the sewage solution. It is a very weak solution, Mr. Riker.

Q. Well, what is the sewage with which you are comparing it?

A. That is colorless, practically colorless; it is not a dyed color at all.

Q. You think it differs from pure clear water in as marked
4179 a degree as the Red R dye solution, do you?

A. In that strength of solution, I should think it would be perhaps a little less marked than the Red R dye solution as Mr. Johnson calls it. At the same time, when you deliver the Red R dye solution, as he calls it, into that salt water there, by the time it has come to the surface, I think the solution would become so thin as not to be visible.

Q. Now, I want to know what the character of the sewage is that you are comparing in your mind the Red R dye solution with?

A. Sewage as I have seen it running through sewers.

Q. Untreated?

A. Untreated.

Q. You are not comparing it with sewage that has been treated in any way?

A. No.

Q. You are not comparing it with an effluent which will produce the results which are guaranteed in Complainants' exhibit No. 135?

A. No, I think not.

Q. Well, don't you know whether you are or not?

A. Yes, I think I know; I think I am not comparing it with any sewage treated as this stipulation proposes this sewage shall be treated before discharged. I don't know that I have ever seen any sewage with such treatment in the way this stipulation suggests this sewage shall be treated. I think I never have, so I could not compare it with that.

Q. So that your comparison now is with sewage different from that which it is proposed to discharge into New York Bay?

A. If the treatment gives a different color, yes.

Q. Well, if the results which are guaranteed in this stipulation are attained, won't the sewage be of a different color?

A. That I cannot answer.

Q. Cannot even express any opinion on it?

A. I would rather not.

Q. Why would yo- rather not?

A. I am not a sewage expert.

Q. It takes a sewage expert to know that, does it?

A. More of a sewage expert than I am.

4180 Q. Well, I draw your attention to one of the results which is guaranteed from the effluent, that there will be absence in New York Bay of visible suspended particles coming from the Passaic Valley. Do you need to be a sewage expert to know that will be an effluent which will be different in its visible character from the sewage with which you are comparing the Red P. dye solution?

A. I have seen some sewage untreated that had no visible suspended particles.

Q. Well, I draw your attention to another guaranteed result, there will be a practical absence on the surface of New York Bay of any grease or color due to the discharge of the Passaic Valley sewage at the dispersion area. Would that have any effect on your view as to the appearance of the sewage or the effluent when discharged?

A. I will answer that in the same way that I did your other question: I have seen some sewage that had no grease or oily substances in it.

Q. Is that the kind of sewage you are comparing the Red dye solution with?

A. That is the kind of sewage I have in mind, yes sir.

Q. That is the kind?

A. Yes.

Q. And you think the red dye solution will be very little less different from clear water than that kind of sewage?

A. I think the effect of discharging it in the water would be about the same.

Q. Won't you answer my question, Professor?

A. I have.

The stenographer read the question, as follows:

"Q. And you think the Red dye solution will be very little less different from the clear water than that kind of sewage?"

Q. Now, will you answer it?

By direction, the stenographer read the answer, as follows:

"A. I think the effect of discharging it in the water would be about the same."

The Witness: That is my answer, Mr. Riker.

Q. I am asking you not as to the effect, but I am asking
4181 you as to the thing itself; looking at the two, do you mean
to say the red dye solution will be little less marked than
the sewage which you are now describing?

A. If you should take a pail of your red dye solution, and a
pail of the sewage that I have in mind you would see a difference.
If you should take that pail of red dye solution and discharge it
into salt water, and take a pail of sewage that I have in mind, and
discharge it into salt water, I think the effect would not be greatly
different.

Q. And if you should take the pail of uranine and discharge it
into salt water, at a depth of 40 feet, and a pail of the sewage,
would the effect upon the surface be very different?

A. Very.

Q. You think you would see the effect of the uranine discharged
at 40 feet?

A. Yes sir, if it came to the surface, you certainly would.

Q. Well, do you think it would come to the surface?

A. All depends on salinity of your water at different depths;
depends upon the direction of discharge and depends upon the
velocity of the discharge.

Q. Professor, you said that this discharge of 360 million gallons
of sewage per day at Robbins Reef as proposed would produce an
intolerable nuisance?

A. That is my opinion and belief.

Q. What is the proposed discharge that you have in mind when
you testify that that would be the result?

A. I was testifying there to a maximum discharge of 360,000,-
000 gallons per day.

Q. Of what?

A. Of sewage.

Q. What kind of sewage?

A. Ordinary sewage.

Q. Untreated?

A. Untreated.

Q. What would be the result in your opinion of the discharge
of 360,000,000 gallons of sewage, treated as stipulated and declared
and proposed in Complainants exhibit No. 135?

A. I don't know what the effect of the treatment would be upon
that sewage, I must make that very clear, because I am not a sewage
expert and have never seen sewage that has been treated like that.

All I can answer to that is that if you are going to discharge
4182 into the waters of the Bay sewage so treated that there will
be no reduction of the oxygen conten' of the water; that is
to say, if you are going to discharge practically a fresh water out
there, then, Mr. Riker, I cannot see why you should discharge it
there at all.

Q. Do you see why that is any of your business?

A. I don't see any reason in the world why you should not dis-
charge it into Newark Bay.

Q. Do you see why that is any of your business?

A. Why, surely.

Q. Why?

A. Well, I won't answer that question.

Q. Well, if the effluent as produced results in the results guaranteed in Complainants' exhibit No. 135, do you think there will be an intolerable nuisance created in New York Harbor?

A. If you are discharging a fresh water with its organic matter entirely oxidized there will not be an intolerable nuisance in New York Harbor.

Q. Is that your answer?

A. That is my answer.

Q. Do you understand that the effluent as described in Complainants exhibit No. 135 will be a fresh water discharge as described by you?

A. That is my idea of fresh water, yes. You are discharging there a water free from visible suspended particles.

Q. Does it say so?

A. Yes.

Q. Read it?

A. (Reading:) "There will be an absence in New York Bay of visible suspended particles coming from the Passaic Valley sewage."

Q. Do you mean to say that that is equivalent to an effluent in which there are no visible suspended particles, in your opinion?

A. That is what it states here, that there will be an absence in New York Bay of visible suspended particles.

Q. Do you mean to say that that is equivalent, in your opinion to an effluent in which there are no visible suspended particles?

A. That is what it states here, Mr. Riker.

4183 Q. All right, that is your answer?

A. You say further, (reading) "There will be an absence of deposits objectionable to the Secretary of War," and you say further "there will be an absence in New York Bay and its vicinity of odors due to the putrefaction of organic matter." That must mean that the organic matter will be oxidized before it gets out there. "There will be a practical absence on the surface of any grease or color due to the discharge." That must mean that it is all removed before it gets there. "There will be no injury to the public health which will be occasioned by the discharge from the said sewer and no public or private nuisance will be created thereby." That must mean you have removed your organic matter completely and anything that would cause disease. "Absence of injurious effects from said sewage discharge upon the property of the United States." That might mean a good many things, I suppose. If it has reference to the discharge of gases, that means that the material in the water has been oxidized. "There will be absence in the reduction of dissolved oxygen in New York Bay resulting from the discharge of Passaic Valley Sewage." That must mean—

Q. Read it all?

A. (Reading:) "To such an extent as to interfere with major

fish life." That must mean that the organic content has been oxidized. Now, that is what I am describing as fresh water.

Q. What is the amount of reduction in the dissolved oxygen which will injuriously affect major fish life?

A. I cannot answer that.

Q. Then, why do you say that the material must have been oxidized?

A. Because if you have any oxidizable material there, you are going to reduce the oxygen content of the water.

Q. Yes, to the extent of injuriously affecting the major fish life?

A. Yes.

Q. That is the stipulation, isn't it?

A. Yes.

Q. What is the amount of reduction which will injuriously affect major fish life?

A. That I cannot answer.

Q. Then how can you testify as to a reduction of the dissolved oxygen?

A. Because if you have any oxidizable material, you are going to reduce the oxygen content.

Q. To an extent that will injuriously affect major fish life?

A. You are going to reduce the oxygen content.

Q. The stipulation limits it to injurious effect on major fish life; do you mean to say it is necessary to have sewer water in order to attain that result?

A. I don't know that.

Q. Then, why do you testify to that?

A. I am testifying just exactly as my answers have indicated.

Q. Don't you understand that the effluent as described by its results in the stipulation is the proposed effluent to be discharged?

A. I understand that that is the proposed effluent, yes sir.

Mr. Riker: That is all, Professor.

Redirect examination by Mr. O'Sullivan:

Q. Professor Ellery, the expression has been used in putting questions to you, "proposed discharge"; what do you understand by these two words?

A. Those are terms used by Mr. Johnson, and I have taken them right out of his testimony.

Q. What do you understand by the two words "proposed discharge"; do you understand that to be the method of discharging the sewage or the sewage effluent, or the substance of the sewage, or the sewage effluent itself?

A. From what Mr. Johnson has stated, I understand the direction of discharge, and the amount of discharge, or volume of discharge.

Q. You mentioned something in relation to the Red R dye. Does Mr. Johnson state in his testimony where he got the Red R dye he testified that he experimented with?

A. He does, from Herman A. Metz & Company.

Q. Did you communicate with Herman A. Metz & Company in relation to that dye?

A. I did.

Q. And what did you find?

A. I find that there is no dye so called on the market, as a Red R dye, at least they have not handled it, do not handle it; and I inquired of several other firms, three or four, and find that they also do not know of any Red R dye.

Q. In what direction were Mr. Johnson's experiments conducted?

A. The discharge was downward.

Q. Does that compare with a horizontal discharge in any way so that you could draw an inference or conclusion?

A. It does not.

Q. What directions did you experiment with in your dye experimentation?

A. In a downward direction, in a lateral or sidewise direction, and in an upward direction.

Q. Vertical horizontal and downward?

A. Yes sir.

Q. I direct your attention, Professor Ellery, to Complainants' exhibit No. 135, and particularly to page 3 of that exhibit, in which the results guaranteed in relation to this sewage effluent are set forth, and ask you if an effluent will correspond with the stipulated or guaranteed results if it would differ materially from the ordinary drinking water?

A. That is my interpretation of that, that it will not; that it will be a fresh, pure water.

Q. Have you had much experience in water analysis?

A. A good deal in water analysis, yes sir.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. Are you a sewage expert.

A. I am not.

4186 Q. How do you undertake to say whether an effluent of this character will be pure water then?

A. From the description that is given of it here.

Q. And when you deal with the proposed discharge, you only deal with the quantity and direction, is that so?

A. I am basing my testimony upon Mr. Johnson's testimony which deals with the quantity and direction of discharge.

Q. I am now examining you upon your re-direct examination Professor Ellery. You were asked what you understood by "proposed discharge" and as I recall it, you said you dealt with the quantity of 360,000,000 gallons a day, and the direction, is that all you dealt with?

A. That is all.

Q. It makes no difference what the quality of the sewage is?

A. As to what?

Q. As to its results?

A. Results on what?

Q. Anything?

A. It makes a lot of difference.

Mr. Riker: That is all.

Mr. O'Sullivan: That is all.

Adjourned to June 26th, 1913 at 10:30 A. M.

4187 Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COM-
MISSIONERS, Defendants.

NEW YORK CITY, June 26th, 1913—10:30 a. m.

Before James D. Maher, Commissioner.

Appearances:

William J. O'Sullivan, Esq., Special Counsel for the People of the State of New York, Complainants;

Adrian S. Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

Met pursuant to adjournment.

RUDOLPH HERING, a witness called in behalf of the Complainants, in rebuttal, being first duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Mr. Hering?

A. Rudolph Hering.

Q. What is your profession?

A. Civil engineer and hydraulic engineer.

Q. Where are you now pursuing your profession?

A. My office is in New York, 170 Broadway.

Q. Are you practicing alone, or are you part of a firm?

A. I am part of a firm, Hering & Gregory.

Q. And previous to that, were you in any partnership?

A. Previous to that I was in the firm of Hering and Fuller,
4188 same office.

Q. Where did you study civil engineering; state where and when?

A. I went to Germany, when I was in my fourteenth year, and went to a preparatory school in Dresden, and later to the Technical High School there, which is the name of the highest institution of learning for engineers.

Q. In what city?

A. In Dresden. I returned home in 1867.

Q. After completing your studies?

A. Yes sir.

Q. And what were you engaged in then in the line of your profession?

A. My first position was in Brooklyn, at Prospect Park, and then at Philadelphia Park.

Q. In what years at Prospect Park?

A. 1868 and 1869 to 1871 in Philadelphia Park. In 1872 I joined the United States Government Geological Survey for exploration in the Rocky Mountains, Yellowstone Park. After that I was assistant engineer in the City of Philadelphia, in charge of the building of bridges and sewers.

Q. Any particular bridge?

A. The first bridge was the Girard Avenue bridge, which crosses the Schuylkill River, in Fairmount Park. I was the resident engineer there from morning until night for a year and a half, until the completion of the work; and then I was engineer,—although not on the work continuously—for other bridges on the Schuylkill River, Fairmount and others, and smaller ones.

I was born in Philadelphia in 1847, and studied civil engineering in Dresden, Germany, from 1860 to 1867. I was engaged in Prospect Park, Brooklyn, New York, from 1868 to 1869; on Fairmount Park, Philadelphia, from 1869 to 1871; on Yellowstone Park Exploration in 1872; was resident engineer on Girard Avenue Bridge, Philadelphia during the entire time of its construction, 1873 to 1875; and Assistant City Engineer of Philadelphia in charge of sewers, from 1876 to 1880.

In 1880, I was engaged by the National Board of Health to report on the sewerage works of Europe. This report was published in 1881.

Since 1882 in private practice. From 1901 to 1911 I was a member of the firm of Hering & Fuller. From 1911 to date I have been a member of the firm of Hering & Gregory.

Since 1881 I have examined and studied the best works of water supply, sewerage, sewage purification and refuse disposal in Europe, during seven visits for that purpose.

In 1907, I received Honorary Degree of Doctor of Science from the University of Pennsylvania.

The following are the principal professional engagements:

Philadelphia, Pa. Surveys and investigations for a new water supply from 1883 to 1886.

Chicago, Ill. Chief Engineer of the Water Supply and Drainage Commission, from 1886 to 1888.

Reports, plans and recommendations for the new water supplies or their extensions, for the following cities:

Atlanta, Ga, in 1890.

Plainfield, N. J., in 1890.

Dallas, Texas Reservoir, in 1891.

Buffalo, N. Y., Reservoir, in 1891 and 1892.

Tacoma, Washington, in 1892.

Colorado Springs, Colorado, in 1893.

Philadelphia, Pa. W. Queen Lane Reservoir in 1896.

Philadelphia, Pa. in 1897 (Schuylkill Tiver, Private Company).

Honolulu, K. I., in 1897.

Winnipeg, Manitoba, in 1897.

Hartford, Conn. in 1898.

Princeton, New Jersey, in 1898.

Sacramento, Cal., in 1900.

Sault Ste. Marie, Mich., in 1901.

Meadville, Pa., in 1901-1904.

San Francisco, Cal., 1903-1905.

4190 Toronto, Ont., Consulting Engineer with S. A. Gray on investigations for a new water supply in 1884.

Santos, Brazil. Consulting Engineer with Prof. E. S. Fuertes and J. H. Fuertes, making design for a new water supply in 1893.

Cleveland, Ohio. Consulting Engineer with George H. Benzenberg, and Desmond Fitz Gerald, recommending improvements for the water supply in 1895.

Philadelphia, Pa., Consulting Engineer with Messrs. S. M. Gray and J. M. Wilson recommending the filtration of the water supply in 1899.

Buffalo, N. Y., Consulting Engineer with Col. Symons and Gen. Field, recommending the new water works intake and other supply improvements in 1899.

Washington, D. C., Consulting Engineer with G. W. Fuller and Allen Hazen, recommending filtration of the water supply in 1900.

New York. Member of Commission with Wm. H. Burr and John R. Freeman, studying possibilities for additional water supply for the City of New York, and recommending the Catskill supply in 1903.

Pittsburgh, Pa., Consulting Engineer with Col. A. M. Miller, U. S. A., and John W. Hill, recommending the filtration of the water supply in 1904.

Acted as Consulting Engineer with George W. Fuller on the water supplies for

New Orleans, La., in 1901. Minneapolis, Minn., in 1910.

Columbus, O., in 1901-1905. Montreal P. Q., Can. in 1910.

Valuations of water supply properties in ten cities, some for the cities, some for private companies.

Acted as expert witness on numerous law cases relating to matters of water supply.

Reports, designs and construction of sewerage systems for the following cities:

4191 Waterbury, Conn., in 1882.

Roanoke, Va., in 1882.

Binghampton, N. Y., in 1882 to 1889.

Duluth, Minn., in 1884 to 1890.

Trenton, N. J., in 1884-1889.

New London, Conn., in 1887-1892.

Montgomery, Ala., in 1888-1891.

- Atlanta, Ga., in 1888 to date.
 Superior, Wis., in 1891.
 Ithaca, N. Y., in 1896.
 Honolulu, H. I., 1896-1899.
 Batavia, N. Y., in 1909.
 Reports, plans and recommendations for systems of sewerage for the following cities:
 Cleveland, Ohio, in 1882.
 Wilmington, Delaware, in 1883.
 Petersburg, Va., in 1884.
 Lynn, Mass., in 1884.
 Altoona, Pa., in 1884 & 1885.
 Pasadena, Cal., in 1887.
 Los Angeles, Cal., in 1887 to 1890.
 Wichita, Kansas, 1888.
 St. John, N. F., in 1889 to 1891.
 Ogden, Utah, in 1890.
 Savannah, Ga., in 1890.
 Oakland, Cal., in 1890.
 Springfield, Mass., in 1891.
 Wilmington, N. C., in 1891.
 East Portland, Ore., in 1891.
 4192 Roanoke, Va., in 1891.
 Indianapolis, Ind., in 1892.
 Sioux Falls, S. D., in 1892.
 Woonsocket, R. I., in 1892 and 1895.
 Hartford, Conn. in 1893.
 Charlottesville, Va., in 1894.
 Ithaca, N. Y., in 1894.
 Portland, Me., in 1894.
 Waterbury, Conn., in 1896.
 Ottawa, Ont., on 1897.
 So. Bethlehem, Pa., in 1897.
 Saulte Ste. Marie, Mich., in 1901.
 Sacramento, Cal., in 1901.
 Chicago Sanitary District, Calumet Sewerage, in 1907.
 Bridgeport, Conn., 1907-1908.
 Providence, R. I. Consulting Engineer for the Improved Sewerage system in 1889-1887.
 Boston, Mass., Consulting Engineer with J. P. Davis on Main Drainage in 1885.
 Chicago, Ill. Chief Engineer of the Water Supply and Drainage Commission, recommending the drainage canal as now built for the disposition of sewage of the City, 1886 to 1888.
 New York City, N. Y. Consulting Engineer from 1887 to 1889 to the Board of Public Works, on its sewerage system.
 Toronto, Ont. Consulting Engineer with S. M. Gray on a sewage disposal system in 1888.
 St. John, Newfoundland. Consulting Engineer recommending system of sewage and disposal in 1889.
 Washington, D. C. Consulting Engineer with S. M. Gray and

F. P. Stearns, recommending design for the sewerage system, in 1890 and 1893.

4193 Newton, Mass. Consulting engineer for the improved sewerage system in 1891-1893.

Victoria, B. C. Consulting Engineer recommending system of sewerage and sewage disposal in 1890.

New Orleans, La., Consulting Engineer with Major Harrod and Major Richardson on the general construction of the sewerage and drainage systems from 1892 to 1907.

Santos, Brazil, Consulting Engineer with Prof. E. A. Fuertes and Jas. H. Fuertes, designing a system of sewerage in 1893 and 1894.

Baltimore, Md., Consulting Engineer with S. M. Gray and F. P. Stearns, recommending design for the sewerage system, in 1895 and 1906.

San Francisco, Ca. Consulting Engineer to Mr. Marston Manson and C. E. Grunsky for the design of a system of sewerage and sewage disposal in 1899.

Columbus, Ohio. Consulting Engineer with George W. Fuller for designing and constructing the sewage disposal works in 1901.

Pasadic Valley, N. J., Consulting Engineer on several occasions recommending a system of sewage collection and disposal from 1901 to 1908.

Reading Pa., Consulting Engineer with George W. Fuller for the designing and constructing the sewage disposal works, in 1906.

Rochester, N. Y., Consulting Engineer with George H. Benzenberg on the sewage disposal works in 1907.

Toronto, Ont., Consulting Engineer with J. D. Watson, England on a sewage disposal system in 1910.

Acted as expert witness on numerous law cases relating to sewage matters.

American Public Health Association. Chairman Committee on Refuse Disposal from 1895 to 1903. In 1912, Chairman of the Section on Sanitary Engineering of this Association.

New York. Member of Commission with H. De B. Parsons 4194 and Samuel Whitney to report on Street Cleaning and Waste Disposal in 1907.

Milwaukee, Wis., Study and report on refuse disposal, and Consulting Engineer during construction of the works in 1907-1909.

Pittsburgh Pa., study and report on refuse disposal in 1908.

San Francisco, Cal., Study and report recommending refuse disposal works in 1909. Now under construction.

Toronto, Ont., Study and report on refuse disposal together with Mr. J. H. Gregory in 1911.

I am also a member of the following scientific Associations:

- American Society of Civil Engineers.
- Institution of Civil Engineers, Great Britain.
- American Society of Mechanical Engineers.
- American Institute of Consulting Engineers.
- Canadian Society of Civil Engineers.
- American Public Health Association.
- Boston Society of Civil Engineers.

American Water Works Association.
New England Water Works Association.
Engineers' Club of Philadelphia.
Western Society of Civil Engineers.
Franklin Institute, Philadelphia.
American Academy of Sciences.
Verein Deutscher Ingenieure.

Q. Mr. Hering, have you any official relationship with the American Public Health Association?

A. I am president of the Association, this year.

Q. And previous to that, did you hold a Chairmanship in any of the Sections?

A. Previous to that I was the Chairman of the Sanitary Engineering Section.

Q. Did the Sanitary Engineering Section take into consideration and make the subject of research, air supplies?

A. Yes, sir.

Q. Did they make researches toward determining the physiology and pathology of respiration?

A. That was one of the duties.

Q. Was it part of their functions to determine the variations in the chemical constituents of air?

A. Yes sir.

Q. Variations in physical condition of the air?

A. Yes sir.

Q. The Bacterial and other particular constituents of air?

A. Yes sir.

Q. Did they take into consideration the condition of the atmosphere of unenclosed spaces, and of enclosed spaces?

A. Yes sir.

Q. Did they take into consideration the control of physical and chemical air conditions in enclosed spaces?

A. Yes sir.

Q. And the control of air conditions in enclosed spaces as regards dust bacteria and odors?

A. Yes, sir.

Q. Was it a function of that section to take into consideration the water supplies that would determine the general quality, the bacteria and other constituents, and the hygienic efficiency, of the water?

A. Yes sir.

Q. Did they take as part of their duties the determination of the effects of aeration and sedimentation on the storage of waters and their thermal stratification on the distribution of plankton, dissolved oxygen and other features of water supplies?

A. Yes sir.

Mr. Riker: The question is objected to on the ground that it is not directed to any testimony offered on the part of the defence.

Mr. O'Sullivan: These questions are pressed with a view to showing the qualifications of this witness and the wide scope of his re-

search and professional activities in determining questions that will be later submitted to his direct inquiry.

The Commissioner: Note the objection of Counsel for the Defendants.

Q. Did that Section take into consideration the ground waters, sprinkling filters and the slow sand filtration, the rapid mechanical filtration, with a view to determining their effects upon water supplies?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes, sir.

Q. Was there a Section of that new division that undertook to determine the pathological and nuisance data in relation to sewage collection and treatment?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes sir.

Q. Did they take under consideration the pathological changes arising from sewage and the conditions favoring and preventing pathological dangers from sewage?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes sir.

Q. Did they take into consideration the sewage disposal problems, the pathological and nuisance data, and the pathological dangers and nuisance from air pollution and effluents at the different styles of purification works?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes sir.

Q. Did they also consider the pathological dangers and nuisances, inherent to the essential features of works for economically purifying sewage?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes sir. Of course, this is in the present tense that I answer it; that is these questions have not all been answered. Investigations have not all been made but it is the present program for the Section.

Q. Did they take into consideration the oxidizing of liquids and the danger from pathogenic bacteria in sewage entering bodies of water, and infecting fish and bathers?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes sir.

Q. Did they take under their consideration the danger from flies and other winged insects which are bred in these sewage filtration and other sewage works?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes sir.

Q. Mr. Hering, did you make a study of the disposal of the sewage of the Passaic Valley Sewerage District and prepare plans for the discharge of this sewage into Upper New York Bay, and submit these plans along with the report on the subject to the Passaic Valley Sewerage Commissioners dated December 31, 1907?

Mr. Riker: The same objection is raised to this:

That it is not rebuttal of any evidence introduced on the part of the Defendants, and it is merely cumulative evidence of the defence.

The Commissioner: Note the objection of counsel for the defendants.

A. Yes sir, in connection with my partner.

Q. Who was your partner?

A. Mr. George W. Fuller.

Q. I call your attention to page 3990 of the record or minutes made by the stenographer at the hearings in this suit, and ask you to consult your copy of the report made by Hering & Fuller for the Passaic Valley Sewerage Commissioners, dated December 31st, 1907, and see if you can find the following quotation from your report therein, as reported on said page 3990 of the stenographic minutes in this case: "The indications are under present conditions that the sewage as it reaches the pumping station on the Newark Meadows will normally be devoid of dissolved oxygen. From the foregoing result it seems quite plain that even though the discharge from the several outlets contribute considerable dissolved oxygen, this will be quite speedily absorbed. In its travel of 20 miles in some 10 hours, it will become septic, but the more or less constant addition along the route of sewage containing dissolved oxygen will retard rapid putrefaction. As received at the pumping station the sewage will doubtless be septic and blackened." Do you find that quotation as I have read it in your report for December 31, 1907, to the Passaic Valley Sewerage Commission?

A. I do so find it.

Q. Was that report along with your plans adopted by the Passaic Valley Sewerage Commission?

Mr. Riker: The objection is made that this is not rebuttal, whether it was adopted or not, and is not within the knowledge of this witness. The proper way to prove that is from the records of the Commission.

The Commissioner: Note the objection of Counsel for Defendants.

Mr. O'Sullivan: The question is pressed for the reason that Mr. Johnson, a witness called by the defense, denied that any such portion of the report existed, and although he had before him what

purported to be a copy of the report, he refused to let me look for just that portion that I have quoted.

A. I presume it was.

Mr. Riker: I move it be stricken out, as not testimony.

The Commissioner: Note the motion of counsel for the defendants.

Q. Do you know, Mr. Hering, whether any changes of your plans for the proposed Passaic Valley Trunk sewer, and the sewage treatment works, and the long outlet sewer from Newark to the vicinity of Robbins Reef light have been made and adopted by the Passaic Valley Sewerage Commission?

Mr. Riker: The same objection, on the ground that the best proof is the proof by the records of the official body which has
4199 the power to adopt or reject them.

The Commissioner: Note the objection of Counsel for the defendants.

A. I believe some changes have been made, although I do not believe,—and have no information regarding it,—of a material nature.

Q. Have you continued your general study of the conditions in Upper New York Bay and New York Harbor since December 1907?

A. I have.

Q. Have you continued your study of the subject of sewage disposal and the discharge into brackish and sea water, since December, 1907, up to the present time?

A. I have.

Q. Have you studied closely the effect of the discharge into salt water harbors, and estuaries in this country and in Europe, since December, 1907?

A. I have.

Q. Have you studied the various methods of treating large volumes of sewage prior to discharge into brackish and salt water harbors and estuaries and have you formed an opinion in regard to the efficiency of such methods in preventing the development of offensive conditions in such waters?

A. I have.

Q. What will become of the excess of the trade wastes and ground water and storm water that reaches the tributary sewer systems, and is excluded from the proposed trunk sewer and sewage treatment works as now projected by the Passaic Valley Sewerage Commissioners.

Mr. Riker: The question is objected to for the reason that it is not rebuttal of any evidence offered on behalf of the defence.

The Commissioner: Note the objection of counsel for the defendants.

A. That excess of storm water will flow over into the Passaic River.

Q. And now as to trade wastes?

A. The trade wastes also, unless they are retained by the producers of the trade waste, and purified.

4200 Q. Has any provision been made that you know of, for such local treatment by the manufacturing plants of their trade wastes?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I am not aware of it.

Q. Mr. Hering, how will the discharge of this excess of liquid composed of trade wastes, ground water and storm water affect the quality of the Passaic River and of Newark Bay after the completion of the project proposed by the Passaic Valley Sewerage Commissioners?

Mr. Riker: The question is objected to for the reasons already given as to other questions and also on the ground that it is immaterial and irrelevant as to what is discharged into the Passaic River, the question under consideration being the supposed threatened pollution of the waters of Upper New York, Bay.

The Commissioner: Note the objection of counsel for the Defendants.

A. It will pollute it to the extent of the polluting material which flows over into the river.

Q. Can you suggest an appropriate way for preventing this fouling of the Passaic River and Newark Bay by these excess polluting liquids?

Mr. Riker: The same objection?

The Commissioner: Note the objection.

A. It was my expectation when connected with the original design of the works that the trade wastes would be kept back, purified, and an effluent satisfactory to the proper authorities discharged into the river. Regarding the overflow of the storm water, excessive flows, it was my expectation that as soon as it would become practicable the two cities connected with the sewer, namely Paterson and Newark, which now have substantially what is known as the combined system of sewers receiving rain water and sewage together, would then have constructed a separate system

4201 whereby storm waters alone, not mixed with sewage, would be discharged into the river, and the sewage alone not mixed with storm water would enter the trunk sewer and be discharged wherever the outfall would be. There was a provision in the act stating that 10 per cent of the trade wastes might be admitted to the sewer. The only use that the engineer could make of this provision was to allow an increased capacity to cover this amount.

Q. Mr. Hering, what will be the character and appearance of the contents of the proposed trunk sewer when it arrives at the proposed sewage treatment works or near the Newark Meadows.

Mr. Riker: The same objection, on the ground that it is not rebuttal.

The Commissioner: Note the objection.

A. Some of the sewage, namely that which arrives from Paterson, the upper limits of the proposed sewer, would be of a different nature from what it is at the lower end, the suspended solid matter would gradually become broken up, large pieces would become small pieces, the dissolvable matter would be taken out by the water, and while there is at the point of discharge from the house a very small amount indeed of dissolved organic matter in the sewage, there would become constantly an increase of such dissolved matter and then at the end of a long flow such as this would be, there would be a very large amount of organic matter dissolved, probably more than half the entire amount. The rest of the organic matter which would be in a solid and colloidal form would be broken up, comminuted, and very difficult to be kept out by straining or screening, and also more difficult to be kept out by sedimentation. The larger particles would settle more rapidly, and more effectually than the fine mostly colloidal matter, most of which requires a long time to settle, and some of which does not settle at all.

Q. Would the sewage be septic?

4202 Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The sewage becomes septic, when the oxygen in the water has been removed by absorption and combination. The speed of this process depends upon the nature of the organic matter, some of which chiefly animal matter, absorbs oxygen very rapidly. After the oxygen is absorbed which is accomplished in the presence of and what are known as aerobic bacteria, then in the absence of the free oxygen in the water another class of bacteria begins its activity. It draws what it needs for its work from the sewage deprived of its free oxygen, and sets up a new process which we call putrefaction, which is accomplished by the evolution of certain gases, some of which are very offensive in their odors, the chief one being sulphuretted hydrogen. In that condition, we call the sewage septic.

Q. Is septic sewage blackened or any other color?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Septic sewage generally has a blackish appearance.

Q. Would you expect the sewage coming from Paterson and Passaic blackened and septic when it reached the Newark Meadows of the disposal works?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I should expect the sewage of Paterson and Passaic to be septic by the time it reached the disposal works, although it is mingled with fresh sewage on the way down. I have seen the sewage of Newark, which would enter at the lowest points of the trunk

sewer, in a septic condition, and of course in that case the septic sewage from higher up would not be changed. If the sewage of a large city like Newark could all be discharged into the trunk sewer in a fresh condition, there might be a reduction of the septic condition in the trunk sewer for a short time, although I
4203 would expect that it would very soon reappear, because the oxygen would be very rapidly absorbed by the peculiar condition of that sewage, and it might be a question of a fraction of an hour, in my opinion, before the entire mass would become septic, although the exact conclusion depends a good deal upon the exact detailed condition of the composite sewage.

Q. Is it a general experience of sanitary engineers to find that septic sewage rapidly infects fresh water?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes, sir, as I have just stated, it accelerates the decomposition, and hastens the putrefaction by the rapid absorption of the remaining oxygen.

Q. How long is it contemplated to detain the sewage in the treatment works and state whether or not the time given is sufficient, in your opinion?

Mr. Riker: The same objection, and the additional objection that the intention of the Commissioners must be properly proved by the production of the records.

The Commissioner: Note the objection of counsel for the defendants.

Mr. O'Sullivan: And before answering the question, Mr. Hering, I will direct your attention to Plaintiffs' exhibit No. 135, which discloses, as far as this suit is concerned the detention period set forth by the Passaic Valley Sewerage Commissioners. (Counsel hands witness stipulation.)

The Witness: According to the document I hold in my hands, being Complainants' exhibit No. 135, giving certain dimensions of detention tanks, it is intended that the tank capacity will always be such as to provide a detention period of not less than one hour at the maximum rate of sewage, and a detention period of the daily
4204 average flow of such sewage of not less than one hour and a half. At the time this document was prepared, certain suggestions were presented to the engineers, myself included.

At that time the progress seemed to be making toward the values of such detentions and I felt that the original proposition, which was put before me, was insufficient and as this document was to be an agreement between two states, I was very anxious that the agreement should be in the line of progress. At that time I was not able to fix any definite time of detention to secure definite results. No money was available to make investigations to settle these facts; the conclusions had to be based upon opinions and I remember very well that I materially increased the time of detention from one point of view and materially decreased it from another point of view. When I say increased it from one point of view, I mean from a detention

to keep out merely what we call grit, the heavy material, chiefly silica, which would enter the sewer from the street washings, chiefly, and which if discharged into the harbor would by its deposit naturally tend to fill the channels. It seemed to me that more than that should be done. Another point of view, at that time very common in our country, was a purification by what was then known as the septic tank treatment. This treatment required a detention of at least 8 hours. This detention was for the avowed purpose of causing putrefaction, and by this putrefying of the sewage to remove a large amount of offensive organic matter chiefly the animal matter and to change it into liquids and thus reduce the quantity of settling suspended solid matter. I felt opposed to this treatment, although most engineers were advocating it. I could not recommend such a long detention on the Newark Meadows believing that that territory will some day become valuable, be built up, and that any septic treatment of sewage would certainly be abandoned in such localities. On the other hand, I felt that a mere retention of the grit was not enough. At that time, as I already stated, progress was being made in Europe in treating such questions. I was not yet convinced that they would be satisfactory, but to allow us to be in the right direction, I suggested at least these dimensions which have been embodied in the agreement and which were neither one nor the other of the older treatments, anticipating what has now become well established, a treatment of inoffensive sludge disposal, by what is known as the Imhoff Tank. These dimensions were embodied in that stipulation, although I could not give any more reasons for them than those I have now given.

Mr. Riker: Will you please put on the record a motion to strike out the dissertation of this witness as not responsive, not in rebuttal of any testimony of the defence, and entirely irrelevant and immaterial to the issue.

The Commissioner: Note the objection of counsel for the defendants, as to the answer of the witness.

Q. Mr. Herring, in your opinion is the detention period set forth in Complainants' exhibit No. 135 a sufficient period of time for the detention to affect the purposes aimed at?

Mr. Riker: The request is objected to on the ground that this witness is already on record in regard to the matter of writing as appears in exhibit for the defence No. 5, and is asked to contradict himself.

The Commissioner: Note the objection of counsel for the defendants.

A. Since the time this document was prepared, a large amount of evidence has been collected so that today I should somewhat increase these detention times or periods embodied in the stipulation.

Q. Mr. Hering, will the contemplated or prescribed treatment set forth in Complainants' exhibit No. 135 render the effluent to be discharged odorless, colorless, and free from visible particles of suspended matter?

Mr. Riker: The question is objected to on the ground that it is not rebuttal of any evidence in the case on the part of the defence, the evidence of the defence being contained in Complainants' exhibit No. 135; that when the effluent is discharged into the waters of New York Bay at Robbins Reef, it will not produce the conditions named in the stipulation, and that there is no evidence that the effluent itself will be of the character involved in this question.

The Commissioner: Note the objection of Counsel for the Defendants.

A. The effluent at the works will not be odorless and will not be free from suspended matter.

Q. And how as to color?

A. It will not be free from color. I mean that the settling tanks at the works on the Newark Meadows, will not remove all the suspended matter.

Q. Mr. Hering, has salty or brackish water a lower or a higher capacity to absorb offensive sewage odors and gases than fresh water has?

A. It has not.

Mr. Riker: Same objection.

The Commissioner: Note the objection.

Q. Which has it, a lower or a higher capacity?

A. The salt water has a lower capacity, less capacity.

Q. Mr. Hering when sewage is mixed with salty or brackish water, is not the odor at or near the point of discharge stronger or more offensive than if the sewage were mixed with fresh water?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. It generally is.

Q. What proportion of the organic matter in sewage is partially dissolved, and what portion partially in colloidal condition, approximately?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. At first, at the point of origin there is very little organic matter dissolved, there is very little outside of the urine that enters the sewer where the organic matter is dissolved, but very soon, as the suspended solid matter is carried along, organic liquids are drawn out, matter is dissolved, and the amount of organic matter in solution increases gradually towards the outfall.

Q. Is it an advantage to treat sewage near its source of origin or some distance from its source of origin?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. That depends. It is generally found most efficacious, most economical to separate the liquids from the solids before adding any further treatment. Liquids and solids can be separated more thor-

oughly the nearer the sewage is to the point of origin. Therefore, if that separation is a desirable part of the process, it is very clear that the nearer you go to the origin, the better you can separate solids from liquids.

Q. Mr. Hering, does the effluent from settling tanks usually contain more dissolved and colloidal organic matter than the sewage before entering the tanks especially if that sewage is septic?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. It does contain more solids in solution, depending upon the time that it has taken to pass through the tank.

Q. Mr. Hering, in view of the characteristics of the sewage and of the waters of Upper New York Bay, and of your recent studies of the action of sewage and sewage effluents as contemplated in exhibit No. 135, would you now modify the recommendations you made to the Passaic Valley Sewerage Commission on December 31, 1907?

Mr. Riker: Same objection.

The Commissioner: Note the objection.

Q. When I had reason to believe that modifications might be made, I communicated this fact to the Commissioners, but they took no action. I also communicated the fact to the Public Press, clearly stating that in my belief from the discoveries that had been made, it would be well to have a revision of the studies, because then the results would be better and the expenses might be less. I have the same opinion to-day.

Q. What modifications are embodied in your opinion as you now hold it?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I believe, although the study has not been made, and conclusions cannot be reached without the expenditure of a good deal of effort, analyses, studies and so on, that economy would result from a quicker interception of the suspended matters, and thereby getting a much better sewage to be discharged into the water courses. The question, the answer to which I do not know is how far the separation can be carried economically, nor at what points or for what cities or towns it would be best undertaken. Furthermore, I am not clear, and I do not see how much clearness could be had without the necessary studies, analyses and experiments, as to whether for some time or not it might be sufficient to discharge the effluent thus freed from solid matter, nearer by, and thus save immediate expense of a large tunnel into New York Bay.

Q. Well, what expression, "the discharge nearer by," what do you really mean by that, Mr. Hering?

A. By that I have in mind the lower part of Newark Bay, near the Kill van Kull, utilizing for dilution chiefly the waters of the Kill van Kull and the waters of Newark Bay, but regarding this as I stated, I have no positive information; I don't know whether it

would be economical, and therefore, I think those studies were entirely reasonable. I think they should have been made.

Q. Mr. Hering, have you examined any of the sewage disposal systems of Europe?

Mr. Riker: The same objection.

4209 The Commissioner: Note the objection.

A. Yes sir; almost all of the sewage disposal systems of western Europe that are of interest and value.

Q. Do you know of any sewage disposal system anywhere in the world where septic sewage has been successfully treated so as to render an effluent odorless and unobjectionable?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes sir, there are in England a number of plants where the sewage is septic and where it is then oxidized in sprinkling filters and is turned out satisfactory to the Government, and in our country here the most prominent case that I am thinking of is Saratoga Springs, where the sewage is made very septic, and where it is afterwards treated on intermittent sand filters, and where it is turned out quite satisfactorily.

Q. Is that the best mode of oxidizing sewage, the sand filtration?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. In my opinion intermittent sand filtration is the most perfect and the best way in which sewage can be oxidized. The oxidation is carried to the highest degree. The results are therefore, better than, for instance, in sprinkling filters, which is generally the most economical plant for oxidizing sewage, but it is not as efficient.

Q. Is intermittent sand filtration or sprinkling filters any portion of the contemplated sewage disposal system of the Passaic Valley Sewerage Commissioners?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I think not, although I am not informed as to what it is proposed to do now.

Q. In speaking of the interception of the sewage of the Passaic Valley District, how near to the source of origin of the sewage
4210 would you think that most desirable?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The separation of the suspended matter from the sewage should be undertaken, as I have stated, as near the origin as possible or practicable, and that will depend upon the particular location of the sewer, and the availability of ground and a number of other things that would have to be examined; but I see no reason why there would have been a great difficulty in selecting such places.

Q. Relative to the communities contributing the sewage would it be more desirable to treat the sewage adjacent to the community that contributed it or at some distance from that community?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. The word "desirable" would depend upon two things, the cost and the possibility of nuisance. Now, if it is much cheaper to treat the sewage nearby and more expensive to take it away, it would of course, in that way be more desirable to treat it nearby. So far as the nuisance is concerned, it is my personal belief that we have reached a state of development when it is practicable to collect and convey, discharge and dispose of sewage without an odor.

Q. By what method?

A. In the first place by the proper construction of the collecting sewers, notably by giving them a very smooth interior, which is usually accomplished by vitrified pipes; secondly, the keeping of these sewers clean by suitable flushing and other means of cleansing as we find in a large number of cities, so that from the house to the sewer outfall, there should be no odor from the sewers, and there is none in a great many cities. It is perfectly practicable to enter the sewers in Europe—ladies have entered them; I have taken my boys into the sewers, and found no offense. There are some sewers

4211 in this country of which you might say almost the same, although we do not give the same care to keeping sewers clean here that they do in Europe. Therefore, the sewage can and should be delivered at the outfall of a city without an odor. Now, then, the question is of further treating it. It has already absorbed oxygen and there is less oxygen in solution. The danger point of our putrefaction is approaching. Therefore, the next point is to get at the matter which causes the putrefaction, and that is primarily the suspended matter before it is dissolved. If you can settle it out inoffensively by the modern treatment, and allow it to change itself inoffensively into a material which remains inoffensive, then you have permanently removed from the whole sewerage system the greatest and chief cause of foul odors. It is an imitation of nature's process, to illustrate it, of rotting leaves in the forest, a gradual transformation of the leaves into humus, into black garden soil; and that is precisely what the sludge is that results from the Imhoff Tanks; it resembles in color and appearance the garden soil; it resembles also in odor. Of course, you will see in it a large number of particles which are different; for instance, hair, which you do not see in the humus. You also see little particles of bone and such matter.

Q. Mr. Hering, can sewage when treated by screening with 4/10 inch mash screens and by sedimentation be more efficiently treated by the separate communities that contribute the sewage, or can it be more efficiently treated by collecting it from the communities and treating it at a considerable distance from its source of origin.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. It can be more efficiently treated by the separate communities because the suspended matter is not broken up so finely, and much of it can be retained even by screens, whereas if it has been conveyed a long distance and churned and comminuted or broken into small particles, screens will do very little good in keeping out suspended matter. For that purpose they are using screens now in Europe of but one millimeter mesh, because it is found that unless you set such fine screens the amount of solid matter that you keep out is too little to make screening worth while. With the Imhoff Tank screening it is not necessary at all except to keep out very bulky matter. Screens 3 inches in mesh are considered sufficient, because the suspended matter retained in the tanks either floats to the surface as grease or it settles to the bottom, and is there gradually converted into inoffensive material.

Q. If the sewer of the Passaic Valley contributing communities was treated at each community with the fine screens and sedimentation that you have described, could the effluent then safely be discharged into the Passaic River?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I don't think that the effluent could be discharged into the Passaic River.

Q. Without further treatment?

A. Without further treatment.

Q. What further treatment would you suggest?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. A further treatment would be possible by three methods, one of which is not practicable, and that unfortunately is the best one, the intermittent sand filtration. The second would be by sprinkling filters. In that way you could oxidize the sewage to an extent that would enable a discharge to be allowed in Newark Bay. The third method, I believe would be the one to be advised, namely a dilution with the waters that are available for such purpose, and to an extent which they will permit. Beyond that extent it would be necessary to adopt some other method of oxidation, and then some oxidizing works, would in the future have to be installed.

Mr. O'Sullivan: He is your witness, Mr. Riker.

4213 Cross-examination by Mr. Riker:

Q. Mr. Hering, you think the effluent as it will be produced from the works that are described in the plans which you prepared could safely be discharged so far as a nuisance is concerned into the Kill van Kull?

A. If the solid material is excluded by sedimentation, if the trade wastes are kept out, as I believe the law provides for, I am satisfied that for some time the effluent could be discharged into Kill van

Kull without creating a nuisance. How long that will continue, I am not prepared to say with any information that I have.

Q. Well, the modifications that you suggested had to do with the point of discharge, had they not; you thought there should be a new study as to the point of discharge?

A. No sir; not with reference to the point of discharge, but to the way of treating the entire question, as to whether the sewage should be collected, conveyed and discharged just as it was proposed in this stipulation or whether there might be some changes.

Q. As to the point of discharge?

A. No, as to the treatment. The sludge removal is, in my mind, more than anything else.

Q. Why have you testified in your direct evidence there as to a proposed discharge in the Kill van Kull as being one of the subjects which you thought should be studied?

A. I should certainly, with the additional treatment of an early sludge removal, say that whole question should be studied again.

Q. And with the belief that the effluent could be discharged without producing a nuisance in the Kill van Kull?

A. No, I don't say that positively; I say it is a matter that should be studied.

Q. Do you know whether or not it has been studied, as a matter of fact?

A. I do not.

Q. Do you know the relative length of line required to discharge into the Kill van Kull as compared with that discharged at Robbins Reef?

4214 A. It would be less expensive.

Q. I did not ask you that; I wish you would answer the question?

A. Length of pipe?

Q. Yes, length of pipe, do you know?

A. I don't know; I don't think there is a very great difference, but it certainly would cost less, and that is the main thing with an engineer.

Q. Have you made a study to find out whether it cost less?

A. No.

Q. Do you know whether or not the Passaic Valley Sewerage Commissioners have made a study to find out whether it would or not?

A. No sir.

Q. Well, didn't you say that your suggestion had not been observed in regard to restudies and further studies?

A. They had not been observed at the time, or shortly after the time when I made the suggestions.

Q. How long ago did you make the suggestions?

A. I guess that must have been 4 years ago, something like that.

Q. Now, Mr. Hering, I show you Defendants' exhibit No. 5, being a communication addressed to the Passaic Valley Sewerage Commissioners, under date of March 25th, 1909, and purporting to be signed by you, among others; do you recognize the signature? (Counsel hands witness paper)?

A. I recognize the signature. (Witness examines paper).

Q. Do you recognize it?

A. Yes sir; if you will allow me, I would like to read it through.

Q. Certainly. Witness reads paper).

A. That is all right, sir.

Q. Who was Edlow W. Harrison?

A. He was the Chief Engineer, I believe, of the Passaic Valley Sewerage Commission.

Q. And who was George W. Fuller?

A. My partner.

Q. This report represents your opinion at that time?

A. Yes sir.

Q. Represents your opinion now?

A. Substantially so, yes sir. There are some details here which might be modified in view of more information, but substantially it does.

4215 Q. How long were you associated with the Passaic Valley Sewerage Commissioners?

A. I don't know when the point of termination occurred, but from the time when they were organized.

Q. As early as December 13th, 1902?

A. Is that when they were organized?

Q. No, I think they were organized a little later than that, perhaps?

A. Well, I was connected with this project from its inception, but it was not the Passaic Valley Sewerage Commissioners; it was the State Sewerage Commission I think, first, that had charge of this matter.

Q. Well, do you remember in connection with a body known as the Passaic Valley Sewerage and Drainage District of Newark?

A. I don't remember that particular name, sir.

Q. Do you think your connection with this project, then, began as early as December, 1902?

A. I think so.

Q. It continued how long?

A. I think until perhaps two years ago, I think, or two or three years ago—three years ago, I guess.

Q. It was more than that, wasn't it?

A. Further back?

Q. Three years ago?

A. Maybe three years ago, I think this document that you just gave me to read was the last communication that was ever sent to them by me.

Q. March 23rd, 1909?

A. That is the last communication I ever sent.

Q. Mr. Hering were you in the employ of the Commission?

A. Yes sir, part of the time.

Q. And you were engaged in the formation of the plans for the purification of the Passaic River?

A. The early plans: just in a general way, because they did not have the funds to make very exhaustive studies, and we used our

judgment as much as possible, based on our experience, instead of verifying all the details by surveys and investigations. However, we did make enough investigation with the means at hand to satisfy us with reference to the conclusion.

Q. And did you approve of the plans that were adopted, so far as you know, by the Commissioners?

A. Some three or four years ago, yes sir.

4216 Q. And did you take into consideration the proposal to establish separate separation works for the separate municipalities?

A. No sir.

Q. Why not?

A. Because it was not at that time known that such a proposition was practicable, for this reason: My first engagement on this work, I think was by the State Sewerage Commission, was brought about in this way—all the communities had prepared plans for purifying the sewage on their own territory from Paterson to Newark, inclusive. These propositions were all considered by the State Sewerage Commission. They were at a loss to know what to do, and they appointed a commission consisting of three engineers to give an opinion. We found after a very exhaustive inquiry that none of the projects that had been proposed for treating the sewage of Paterson and Passaic and of the other cities including Newark, could be recommended; and we were ready to turn down the entire lot and say that we could not approve of any. Then it occurred to us that it might be possible to unite all of the towns with a trunk sewer, as has been proposed before that by an engineer, and we looked into this proposition, although without instructions. This was a proposition to discharge the sewage at the lower end of Newark Bay. We came to the conclusion, however, that this solution would not last very long. I believe the figure was made—but that was merely an estimate—it might last ten or fifteen years and then it might become objectionable. We then turned to New York Bay, and that was the origin of the proposition to discharge the sewage into a much larger body of water with the expectation that the time when this would no longer be possible or practicable was so remote that it did not have weight at the time when making the recommendations.

Q. That discharge was untreated sewage, wasn't it, that was proposed at that time?

A. Yes sir, that was all untreated sewage.

Q. Now, what I want to know is why in your complete connection with the proposal down to 1909 or 1910, you did not suggest the separate cleaning and the sedimentation of the separate municipalities as you now say is desirable from some point of view?

A. As long as I was engaged, I had no other information
4217 except that which was before us, and under those circumstances, it was utterly impossible or impracticable I will

say, to have every community treat its own sewage.

Q. Was it impracticable to have them screen and sediment it?

A. Well, that was not an entire treatment of sewage.

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Q. That was the question that was asked you on the direct examination, Mr. Herring, whether that was desirable?

A. That is, of course, desirable; but it is not a complete treatment of the sewage?

Q. Is there anything new about screening and sedimentation as compared with your work with the Passaic Valley Sewerage Commission?

A. There is something new regarding sedimentation which is so materially and substantially new that it practically revolutionizes all sewage treatment.

Q. What is that?

A. That is the inoffensive sludge decomposition.

Q. By the Imhoff Tank?

A. Yes sir.

Q. So that, that is what you were testifying to in answer to the direct question as to sedimentation and screens, as applied near by by the separate municipalities?

A. Yes sir, if it is done today; the sedimentation today by means of the Imhoff method is wholly different matter from what it was five or six years back, when we were not yet familiar with it.

Q. Well, what additional treatment would be necessary for the effluent after it has passed through the Imhoff Tanks, then?

A. The additional treatment of the effluent when it is fresh, and that is the other question that is of great importance, is either an oxidation by water or an oxidation on land by what we call filtration, although the sprinkling filter is not a true filter, but it is so called.

Q. And you think it would be an economical thing for those separate municipalities to install the Imhoff Tanks and the Sprinkling filters or other oxidizing devices for the effluent as compared with the Passaic Valley Sewerage scheme?

4218 A. It is very economical for some, those which I have investigated.

Q. And you think it would be as economical to treat the municipalities separately, do you?

A. I have only investigated the question so far as a few towns are concerned; I am not prepared to say whether it would be applicable to any of the other towns, because I have not investigated it. But I did urge in public print some years ago that such investigations be made. I do not know whether they have been made or not. I merely believed at that time that they had not been made, because—or some little time afterwards—because of some remarks which I saw in print emanating from some employees of the Commission.

Q. And since you severed your connection with the Commission, you have been retained by Montclair, haven't you?

A. Yes sir, I have been retained by Montclair, Orange and East Orange.

Q. Municipalities which have refused to come into the joint sewer project?

A. I believe they have so far refused to go in.

Q. And you have there recommended the Imhoff System, I think, have you not?

A. Yes sir.

Q. What interest have you in the Imhoff system?

A. If you mean financial interest, not one cent; never had, have not, and never will have.

Q. If the municipalities in question do not adopt the Imhoff system, is there any way that you know of in which they can dispose of their sewage independently of the Passaic Valley Sewerage project?

A. I do not.

Q. When you made the report which is Defendants' exhibit No. 5, dated March 25th, 1909, had you made an estimate of what the Passaic Valley sewer would cost?

A. Yes, sir.

Q. How much did you estimate?

A. The estimate which we made at that time, I think, was about \$13,000,000.00.

Q. And you know that the Commissioners were considering the adoption of your plans and the discharge of the sewage upon that plan into New York Bay, did you not?

A. Yes sir.

4219 Q. And contemplated the expenditure of \$13,000,000.00. upon it, did you?

A. Yes sir.

Q. Are you under subpoena here today?

A. I have been requested to be here.

Q. I am asking you whether you are under subpoena, under process of the Court?

A. You mean whether I have a—whether I saw a piece of paper on which I—

Q. Do you know what process of the court is?

A. Well, a subpoena, I remember, because I have sometimes been shown a subpoena.

Q. Are you here under subpoena?

A. I do not think I have seen a piece of paper which you call a subpoena.

Q. Don't you know whether you are here under subpoena or not?

A. I don't know, no sir.

Q. You don't know whether you have received a subpoena?

A. I have been requested by Dr. O'Sullivan to be here.

Q. Are you here under retainer?

A. No sir.

Q. You are not to be paid for your testimony?

A. Yes sir.

Q. You are to be paid?

A. Yes.

Q. How much are you to be paid for being here?

Mr. O'Sullivan: I object to that and instruct the witness he need not answer.

The Commissioner: Note the objection of counsel for the Complainants.

A. I am here expecting to be paid what I am paid from almost all other clients, and what is the regulation charge under the code of the American Institute of Consulting Engineers, which is a minimum fee of \$100.00 a day.

Q. Do you understand the purpose of this suit?

Mr. O'Sullivan: I object to that.

The Commissioner: Note the objection of Counsel for the Complainants.

4220 A. I presume the purpose of this suit is to prevent the State of New Jersey from fouling New York Bay.

Q. Don't you understand the purpose of the suit is to prevent the State of New Jersey and the Passaic Valley Sewerage Commissioners from putting into actual operation the plan which you approved and submitted to them?

A. I don't know how far the details go.

Q. You know that you are here at the request of the Complainants, don't you?

A. Yes sir.

Q. And you know that the purpose is to prevent the carrying into actual effect of plans which you have submitted and which you have approved in Defendants' exhibit No. 5, don't you?

Mr. O'Sullivan: I object to the question; it relates to nothing that has been brought out on the direct by this witness.

Mr. Riker: It relates to the competency and qualifications of this witness.

The Commissioner: Note the objection of Counsel for the Complainants.

A. I know that, sir, and I have already testified that if I were to advise on this Passaic Valley Sewerage treatment, I should certainly advise differently owing to the very radical changes that have occurred since that time; and in view of the present economical possibilities of treating sewage in a better way, all of which would cause me, as a consulting engineer, to advise something better than I did a few years ago, when nobody on this earth knew about the possibilities of which we know today, and of which we have absolute proof.

Q. Do you mean to say by that that you are now of the opinion that the discharge of the effluent as proposed will not produce the results that are guaranteed in Complainants' exhibit No. 135 which is before you?

4221 A. I am of the opinion that for a while and for a time—how long I do not know—this discharge as specified here with only slight exceptions that would no doubt be made in the course of developments, will not cause a nuisance, that is, for a certain time, the length of which I do not know. I know today that another way is possible, and a better solution is possible by utilizing discoveries

and practice- that have been made since that time, and I always recommend that which is best known at the time of the recommendation.

Q. I ask you again whether you have changed your opinion as to the effect of the effluent which will be produced at the proposed pumping station on the Newark Meadows when discharged into New York Bay, as to whether it will or will not for the maximum sewage intended to be conveyed by this sewer, will result as specified in the stipulation which is Complainants' exhibit No. 135?

A. I don't think that it would cause a nuisance today, just as I have stated before.

Q. That maximum discharge of 360,000,000 of gallons today?

A. That I am prepared to say today.

Q. What has changed your mind in regard to the nuisance, if it is that, since you made your report and recommendations to the Passaic Valley Sewerage Commissioners, embodied in Defendants' exhibit No. 5?

A. The discovery of the inoffensive sludge treatment of sewage.

Q. How does that affect the results which will be obtained from the proposed treatment that is embodied in Complainants' exhibit No. 135 and its effect in New York Harbor?

A. It has a very great effect, because if you keep the sludge out and convert it inoffensively into material that is not objectionable, you can utilize this means of sewage disposal, for a very very much longer time, how long I cannot say. Therefore, it is decidedly more economical and to be advised.

Q. Well, what I want you to answer, Mr. Hering, if you will, is whether or not you have changed your mind as to the result
4222 in New York Harbor of an effluent produced as proposed and described in Complainants' exhibit No. 135, whether it will cause a nuisance in New York Harbor?

A. Not today, as I have stated already.

Q. Well, when will it?

A. That I have stated nobody can tell. It is a question of time how long this will last, and that is precisely the question which an engineer meets with every one of his works, they are built up to a certain time. Now, if he can effect some modification, some improvements, it will last a longer time.

Q. That does not mean anything more, does it, Mr. Hering, than that the more you purify the effluent the longer you can discharge it; does it mean anything else?

A. That is what it means.

Q. It does not require an expert to know that, does it?

A. Sometimes it does.

Q. How long did you calculate that the Passaic Valley sewage would require additional purification so far as the length of time of its discharge was concerned; in other words, how long did you calculate the life of this sewer to be?

A. I did not calculate it; there is no way of calculating it.

Q. You did not calculate it?

A. No sir.

Q. You did not design it for any specific length of time?

A. The sewers were designed for a certain population and a certain amount of sewage, but just what the effect would be of the discharge, it was utterly, impossible for anybody to calculate with the knowledge then available.

Q. Now, Mr. Hering, the sewers are proposed for a definite carrying capacity, are they not?

A. Yes sir.

Q. And taking the maximum capacity, carrying capacity, of the sewers, do you think there is any question that an effluent of sewage that is represented by the total carrying capacity of the sewers, treated as specifically described in Complainants' exhibit No. 137, will not result in a nuisance in New York Bay?

A. I cannot tell.

4223 Q. Why didn't you advise the Commissioners to that effect when you are called upon to advise them, if you could not tell?

A. Because there was not a man living who could tell.

Q. Didn't you recommend they should go into this project?

A. Yes, sir.

Q. With a sewer that was designed to have a specific carrying capacity?

A. Yes sir.

Q. And didn't you advise them that in your opinion there would be no nuisance produced in New York Bay from that sewer?

A. Yes sir, that there would not be at first.

Q. Have you changed your mind?

A. I have already stated that I have changed my mind in the prior method of treating the sewage. It is today possible to lengthen the life of the works and of the discharge ver- materially by a better treatment of sewage which has been discovered since that time.

Q. Is that better treatment impossible of application to the sewage at the proposed disposal plant?

A. Yes sir.

Q. Why?

A. Because the sewage when it reaches the disposal plant—I don't know what you call the disposal plant, the outfall or the pumping station—well, at either place, I will say the character of the sewage is such that it would be very difficult and expensive to treat it in the Imhoff way, because of the fact that the sewage has been comminuted, that the settling will be very slow, that the sewage would become septic or likely to become septic, and that the settling time would have to be so long that altogether there would be the creation of a nuisance, and that is not what I should recommend.

Q. And since you have ceased your connection with the Passaic Valley Sewerage Commissioners, and ceased to be under their pay, you have come to the conclusion that the plans which you have recommended should be displaced by some others, is that it?

A. Partly so, but if I may substitute, I informed the members

of the Commission and the President of the Commission of all these facts by personal visits, and by a personal report that 4224 a re-investigation of this question should be made.

Q. That is since you ceased to be connected with them, is it not?

A. Yes sir.

Mr. Riker: That is all.

The Witness: I don't know whether that is literally true or not, but during the latter part of the engagement or afterwards, I do not know exactly when the engagement terminated, there was no definite time.

Mr. Riker: That is all.

Redirect examination by Mr. O'Sullivan:

Q. Mr. Herring, directing your attention to Defendants' exhibit No. 5, at page 3, I ask you if you recall reporting that the very finely divided suspended organic particles and the dissolved organic matters of the sewage will, under the proposed conditions of dispersion be carried into the water into which they will be discharged?

A. Yes sir.

Q. Mr. Herring, directing your attention to page 1 of Defendants' exhibit No. 5, I ask if you recall—taking the second paragraph of that report,—this fact: That: "This statement is prepared for the purpose of securing cooperative action to decide the details of this method in a manner satisfactory to the parties in the pending suit between the States of New Jersey and New York and the United States in accordance with the understanding arrived at during the conference held in the office of Attorney General O'Malley, in New York City, on March 11th, 1909." I ask you if you recall that that statement was prepared with that object in view?

A. I do.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. And the object was to be carried out and into effect by the construction of the sewer was it not?

A. I presume so; the construction of some sewer, and the construction of some works.

Q. And the plans that were recommended by you to the Commissioners were intended to carry this into effect, were they not?

4225 Q. And they are embodied in Complainants' exhibit No. 135?

A. Yes sir.

Q. You understood at the time that they were satisfactory to the City of New York, did you not?

A. I did not have any knowledge of that at all.

Mr. Riker: That is all.

Mr. O'Sullivan: That is all.

Adjourned to June 27th, 1913 at 10.30 A. M.

Supreme Court of the United States, October Term, 1912.

THE PEOPLE OF THE STATE OF NEW YORK, Complainants,
against
THE STATE OF NEW JERSEY and PASSAIC VALLEY SEWERAGE COM-
MISSIONERS, Defendants.

NEW YORK CITY, June 27th, 1913—10:30 a. m.

Before James D. Maher, Commissioner.

Appearances: William J. O'Sullivan, Esq., Special Counsel for the People of the State of New York, Complainants;

Adrian S. Riker, Esq., of Counsel for the Passaic Valley Sewerage Commissioners, Defendants.

4226 Met pursuant to adjournment.

J. WILLIAM GRIFFIN, a witness called in behalf of the complainants, in rebuttal, being first duly sworn by the Commissioner, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name?

A. J. William Griffin.

Q. Where do you reside?

A. In Jersey City.

Q. Professionally, what is your occupation?

A. I have been Superintendent of the Water Works of the Water Department of Jersey City since the year 1906. Previous to that I was Superintendent of the New York and New Jersey Water Company for a period of ten years and have had extensive experience in public works construction and operation.

Q. Were you in charge of the litigation conducted by Jersey City against the Jersey City Water Supply Company?

A. I was in complete charge of that litigation and conducted the case which extended through a period of four years.

Q. Did you ever reside in Arlington, New Jersey, and if so, when?

A. I resided in Arlington, New Jersey from October 1898 to 1909.

Q. Are you familiar with the pollution of the Passaic River by the sewage of the cities in the Passaic Valley?

A. I am.

Q. Have you knowledge of the plans of the Passaic Valley Sew-

erage Commission relative to the disposal of the sewage of the Passaic Valley district?

A. I have.

Q. In your opinion will the discharge of this sewage as proposed at Robbins Reef Light in accordance with these plans affect the health and property of the citizens of Jersey City?

Mr. Riker: One moment. I object on the ground that it is immaterial and irrelevant and not in issue in this case.

The Commissioner: Note the objection of counsel for the defendants.

A. It will. I appear voluntarily in this case to protest against the discharge of this sewage into New York Bay on the ground that it will create a nuisance in the waters of the Bay which will seriously affect the business interests the property interests and health of Jersey City.

Q. On what do you base your opinion that the discharge of this sewage will be a damage to Jersey City property and to the health of Jersey City's citizens?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I know now that the sewage from these towns creates a nuisance in the Passaic Valley, affecting the health and property of the citizens therein and that this nuisance is the chief reason why the cities in the Passaic Valley have joined in a plan to carry the same out of the valley through the trunk line sewer proposed by the Passaic Valley Sewerage Commission. I believe that this pipe line will simply transfer the nuisance which exists in the Passaic Valley to the water front of Jersey City, and the other municipalities on New York's upper Bay. This is apparent on inspection of a panoramic map which I herewith produce. It shows the relation of Jersey City to the site of the area of discharge. (Witness produces map.) This map has got several proposed improvements on it that do not exist at the present time, such as the Ship Canal of Newark and the Hudson River Bridges.

Q. Does that panoramic map show the relation of Jersey City to the proposed sewer outfall and to the location approximately of the sewage disposal works on the Newark Meadows?

A. It does.

Mr. O'Sullivan: I offer that map in evidence for the purpose of showing the relative location of Jersey City to these two points, and ask that it be marked in evidence as Complainants' Exhibit No. 217.

Mr. Riker: I want to ask a few questions about this.

Cross-examination by Mr. Riker:

Q. Did you make this map?

A. No, sir, I did not.

Q. Did you ever observe this locality from a point corresponding?

A. Well, only my general knowledge of the situation.

4228 Q. Your general knowledge of the situation corresponds with that?

A. Yes, sir.

Mr. Riker: The offer is objected to on the ground that it is not properly proved, is irrelevant, immaterial and not rebuttal of any evidence offered by the defense.

The Commissioner: Note the objection of counsel for the defendants.

Said map was received in evidence and marked Complainants' Exhibit 217.

Mr. O'Sullivan: He is your witness, Mr. Riker.

Q. I show you Complainants' Exhibit No. 135, and ask you whether you have ever seen this exhibit, or a copy of it? Examine it, please?

A. I have seen a copy of it, yes, sir.

Q. Is the discharge which you say you think will prove to be injurious to Jersey City, the discharge which is described as to its results in the second stipulation in that instrument? (Counsel hands witness exhibit No. 135.) Examine and read it?

A. (Examining exhibit.) It is.

Q. You think that an effluent which when discharged into the waters of the New York Bay would produce no visible suspended particles coming from the Passaic Valley Sewerage and from which there will be an absence of deposits objectionable to the Secretary of War of the United States, and in which there will be an absence in New York Bay and its vicinity of odors due to putrefaction of organic matters, contained in the sewage of the Passaic Valley, as thus described, and from which there will be a practical absence on the surface of New York Bay of any grease or color due to the sewage of the Passaic Valley and from which there will be no injury to the public health which will be occasioned by the said sewage in the Bay of New York in the manner proposed, and no public or private nuisance created thereby—will be a nuisance to the City of Jersey City?

A. I do.

Mr. Riker: That is all.

4229 Redirect examination by Mr. O'Sullivan:

Q. Mr. Griffin, have you also had your attention directed to the screening and the sedimentation to be employed in the production of that effluent?

A. I have.

Q. Will the means and the plant inscribed in Complainants' Exhibit No. 135 produce the effluent, the results of which are guaranteed in that stipulation?

A. It will not.

Mr. O'Sullivan: That is all.

Recross-examination by Mr. Riker:

Q. If they do produce the effluent which is guaranteed in that instrument, in your opinion, there will be a nuisance created?

A. It is impossible for them to produce such an effluent.

Q. That is your opinion?

A. It is, yes, sir.

Q. If they do, however, contrary to your opinion, produce such an effluent, is it your opinion that it will create a nuisance?

A. According to the plans that I have seen, it is impossible to produce it.

Q. I do not ask you that; I ask you to answer my questions, that if the effluent does result as guaranteed, do you think there will be a nuisance created thereby in New York Bay?

A. I will have to answer that as I answered it before, that you cannot produce an effluent of that kind according to your plans. If the effluent that they propose, according to the specifications of the United States Government were procured, there would be no need of carrying it into New York Bay, they would be as all up-to-date disposal works, and that is to discharge it into the nearest water way.

Q. You don't mean to be understood, do you, that such an effluent cannot be produced?

A. I do not, because it can be; but not according to the plans that have been shown me.

Q. Now, if such an effluent is produced, which you say is possible, you think it nevertheless will be a nuisance if discharged into New York Bay?

4230 A. I do not, but the only thing I say about that is that you would not carry it into New York Bay if you proposed to discharge an effluent of that character.

Mr. Riker: That is all, Mr. Griffin.

Mr. O'Sullivan: That is all.

OLIN HENRY LANDRETH, a witness in behalf of the Complainants, recalled, in rebuttal, testified as follows:

Direct examination by Mr. O'Sullivan:

Q. What is your full name, Professor?

A. Olin Henry Landreth.

Q. Have you testified previously in this suit?

A. Yes, sir.

Q. Has your attention been directed to testimony given by Mr. George A. Johnson, an expert witness called on behalf of the defendants in this suit?

A. It has.

Q. Have you taken up any matters testified to by Mr. Johnson, and if so, state what?

A. I have. I have taken up the testimony given by Mr. Johnson concerning his tests with colored liquids for the purpose of conclud-

ing as to the diffusion of sewage when discharged into the Upper Bay at Robbins Reef.

Q. Have you conducted any experiments yourself along the lines testified to by Mr. Johnson?

A. I have. I have made a series of experiments to determine the influence of the velocity with which the sewage is discharged on its appearance on the surface. Mr. Johnson's testimony went to the question as to the probable appearance of sewage on the surface of the harbor, as judged by his examination of the appearances or non-appearances of a colored dye on the surface of the harbor waters, and he endeavored to show that his experiments with the colored dye would lead to corresponding results with sewage. I desire to show that granting his experiments of the colored dye, they are sufficiently dissimilar to what will take place with the sewage

4231 to render a conclusion as to the identity of results of little value. The experiments made by Mr. Johnson with the colored dye differed from the conditions which will prevail in the discharge of sewage in two essential particulars. In the first place, the experiments with the dye by Mr. Johnson were made at a high velocity of discharge, the actual discharge of sewage from the future sewers according to the specifications and general description of that system will be at a low velocity. The experiments made by Mr. Johnson were conducted by discharging the colored dye in a vertical downward direction; the discharge of sewage from the sewer outlets will be either a vertical direction, or, at best, in a horizontal direction, and my experiments go to show that there is a very striking contrast in the appearance of a dye on the surface of water when discharged in a downward direction as compared with either a vertical, upward or even a horizontal direction. I also made comparative results to observe the effect of the difference in salinity of the water into which the dye was discharged as between pure, fresh, soft water on the one hand and sea water of the average salinity of the harbor water on the other. I also conducted some experiments for the purpose of showing the influence on diffusion of the quietness of the water into which the discharge was made. That, however, was not in rebuttal of anything which Mr. Johnson said, but was to throw additional light on the question and that series is not yet complete.

Q. Does motion and quiescence influence diffusion?

Mr. Riker: The question is objected to because it is not rebuttal of anything in defendants' evidence.

The Commissioner: Note the objection of Counsel for the defendants.

A. It does.

Q. Will you describe in detail the experiments which you conducted, describing first the apparatus and the agents employed and the observations made as the result of your experiments?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes, sir. The apparatus employed comprised a large reinforced concrete tank, sunk in the ground 20 feet in length and 10 feet in width and 5 feet in depth. The surface of this tank was colored white, so as to render it possible to detect faint differences of color in the water. The coloring agent employed was a dye of the same color and strength of color as that employed by Mr. Johnson. The discharge was made through a system of piping extending from the upper portion of the building down to the tank with a portable pipe having an orifice, with arrangements to regulate the velocity and arrangements also to alter the direction of the jet. The jet could be turned vertically downward or vertically upward, or horizontal in either position, or in the four directions of the quadrant, and could be lowered to any height, and could be placed in any part of the tank. The velocity was regulated by calibrating a valve on the pipe so that by setting the valve at any given degree of opening, any velocity could be obtained from zero to 15 feet per second of discharge. We actually employed for most of the series velocities of $1\frac{1}{2}$ to 2 feet per second, and velocities of 10 feet per second. In Mr. Johnson's experiments he employed a velocity of about 10 feet per second. He indicates that, not by stating the velocity, but by stating the volume of coloring matter discharged per second, and also by stating the diameter of the discharge pipe, and from that a simple computation indicates that his velocity in most of his experiments was 10 feet per second, and that in a few of them it dropped a little below 10 feet a second, but I think in no case below 9 feet a second. The rates of discharge when the sewers are discharging at their maximum into the bay will according to the plans thus far indicated produce a discharge of approximately 2 or $2\frac{1}{2}$ feet per second, of liner velocity, into the bay. The observations made were 4233 first to direct the jet in a horizontal direction and to open the valve to a slow velocity, a velocity of about 2 feet per second, and to discharge a certain quantity of coloring matter, and then to move the apparatus to a portion of the tank where the water was clear and at once discharged the same quantity at 10 feet per second, and this was repeated in the reverse order, starting again with the high velocity and closing with the slower velocity; and the results were that the high velocity in every case produced a greater diffusion of the colored matter in the water than did the low velocity, thus making it more difficult to ascertain or discern the appearance of the colored dye on the surface than it would have been had the velocity been lower. The next series which were conducted for the purpose of showing the effect of direction were made by discharging the colored dye at velocity of 10 feet per second in a vertical downward direction, and at different depths of water starting with 5 feet, again with 4 feet, 3 feet, 2 feet, and 1 foot in depth. In every case the discharge of liquid descended to the bottom of the tank where it struck the floor of the tank and spread out in a thin circular sheet, diffuse and so thin that even in the case of the salt water it failed to rise and did not rise, of course, in the fresh water, but remained on the bottom. Then the next step in that series was to change the direction to vertically upward, and in that case the colored jet appeared at once

on the surface, whatever the depth of discharge. It was only a little later when the maximum depth was used than when the first depth was used. But in each case the colored dye came to the surface in a compact form or cylinder, and as soon as it struck the surface, spread out in a circular disc in all directions just like that on the bottom. The third step in that series was to project the jet of colored dye in a horizontal direction at the velocity employed by Mr. Johnson. In the Fresh water the jet or colored portion of water which escaped moved horizontally and diffused laterally, forming

substantially a horizontal cone with the vortex at the
4234 point of discharge and the base at the farther point. When

I speak of that as a cone I want to qualify that by saying that the sides of the cone were not straight, but curved, so that the diameter of the base of that cone increased faster than the length increased. It was, therefore, a cone with concave sides, if we may call that a cone. In the case of salt water that same cone was formed except that it tended to rise and the base of it approached the surface and ultimately reached the surface, while nothing occurred of that nature as to rising or sinking when fresh water was employed. This series of observations on the influence of direction was repeated in different directions and at different depths. When the discharge was near the surface of the tank, the base of the cone reached the surface, naturally much sooner than it did when it was placed at a lower depth, but, apart from that, in no case did the color reach the top except by expansion of the base of the cone whereas in the case of the harbor water, with the salinity, the whole cone bent upward and reached the surface not only by expansion of the cone, but also by the buoyancy, causing the cone to rise to the surface. My experiments also included a series which has not yet been completed, showing the effect of quietness of the water into which the colored jet was discharged. Thus far the results indicate without any exception, and without any contradictory observations, that diffusion is accomplished primarily, if not solely, by the physical movements of the water into which the material is discharged, and that that state of movement or non-movement depends on the time which has elapsed since some cause of agitation has occurred. In the case of tanks recently filled with a hose, although the water seemed to be entirely quiescent, so far as indicated by any eruption or ripples on the surface is concerned, it was plainly ascertained that the water was internally moving, but that that motion, those internal eddies and movements were gradually overcome and that the water came
4235 to rest gradually with time, and that water which was allowed to stand for 24 hours in this tank without any disturbing cause, while it still had very decidedly less movement internally than when originally filled, it also had some movement and as judged by small size experiments, not on the large tank, but on the glass jars, the effect of long continued rest on producing quietness was extended still further for two or three days. That covers substantially the general results of the series and experiments with dyes.

Q. What conclusions did you draw from your experiments, and as applied to the experiments of Mr. Johnson, what criticism do they imply from your observations?

Mr. Riker: The question is objected to as not being proper rebuttal; the question should be directed as to the specific testimony of the defense.

The Commissioner: Note the objection of counsel for the defendants.

A. My conclusions are that the conclusions which Mr. Johnson reached, that simply because the dye did or did not reach the surface in the case of his experiments, he therefore concluded that the sewage would not reach the surface, my belief is that that conclusion is unfounded and is without any validity for the reasons stated by me in the first part of my questions, namely, that the velocity of discharge was different in the case of Mr. Johnson's experiment, than in the case of the sewage discharge; secondly that the direction of discharge is different in the case of Mr. Johnson's discharge and in the sewage discharge; and since I have shown that both these contribute to the question of appearance of dye on the surface of water, I feel warranted in believing that no conclusion could be drawn concerning the appearance of sewage on the surface of the bay from Mr. Johnson's series of dye experiments as to the appearance of that dye on the surface of the bay.

Q. Since you testified on direct in the Complainants' case 4236 originally, have you made any further inspections of the harbor conditions to determine the problems of diffusion of sewage with waters in the harbors and streams and if so, state where.

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. I have. I have made some additional inspections in New York Harbor, also on the Albany water front, also in the Troy water front, also in Schenectady at the discharge of the sewers into the Mohawk River, also from the City Ottawa into the Ottawa River and into the Rideau River and Canal, also into Prescott water front from the City of Prescott, Ontario, into the St. Lawrence; also from the City of Kingston into Lake Ontario; also from the City of Toronto into Toronto Harbor, which is a part of Lake Ontario, also from Niagara Falls into the Niagara River; also into the Niagara River from the City of Buffalo; also in Tonawanda Creek, from the Village of Batavia; also from Rochester into the Genesee River; also from Syracuse into Onondago Creek and the upper end of Onondago Lake. These inspections which were all in fresh water, were specially made for the purpose of observing the influence of quietude of the water into which the discharge was made as affecting the rate of diffusion; and I can give the details of these observations, if you wish, but in general they indicated very definitely and positively that the rate of diffusion depended in almost sole measure on the agitation or motion of the water into which the discharge of sewage was made.

Q. Professor Landreth, has your attention been directed to the testimony given by General Robert, an expert witness called on behalf of the defendants in this suit?

A. It has.

Q. Directing your attention now to Complainants' Exhibit No. 135, to the plant described on pages 1 and 2, and page 3, and then directing your particular attention to the second paragraph on page 3, marked with the figure "2" which states there will be 4237 absence of deposits—I ask you whether or not in your opinion this effluent produced by such a plant, will or will not leave deposits that may obstruct navigation?

Mr. Riker: The question is objected to as not being rebuttal, also on the ground that there is no testimony of any kind of any obstruction to navigation; there is nothing in the stipulation that it is obstructing navigation.

The Commissioner: Note the objection of Counsel for the defendants.

A. Basing my answer on the testimony of General Robert, I should say it would produce deposits objectionable on the bottom of the Harbor. While General Robert's answer related to the production of deposits in Newark Bay, and this plant is proposed to discharge into New York Bay, I fail to see wherein the discharge of an amount of deposits represented by General Robert, will be lacking in harmfulness in New York Bay, if the volume equals the amount indicated by the General for Newark Bay. I assume, of course, that in New York Bay the deposits would be scattered over doubtless a somewhat larger area, but while that difference would produce a helpful influence so far as the time when they become objectionable is concerned, on the other hand, they would produce a harmful difference as to the area of the Bay affected. In other words, the date when the objection will become visible as serious would be delayed in New York Bay as compared with Newark Bay, but the area covered would be extended and very much larger.

Q. Is there any peculiarity in conformation of New York Upper Bay in its main Ship Channel that would support the views you have expressed?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

A. Yes, sir.

Q. Will you state what they are Professor Landreth?

Mr. Riker: The same objection.

The Commissioner: Note the objection.

4238 A. The point proposed for the place of discharge of the Passaic Valley Trunk Sewer outlet is on the westerly slope of the Main Ship Channel in a depth of water approximately 40 feet and just above Robbins Reef. Below that point there are several ridges, which run across the channel which ridges, in each case, tend to form barriers, which would prevent the deposits from passing out to sea. There is one that is very close to the point of discharge. There are other smaller ones within a mile or so, and the main bar through which Ambrose Channel passes forms another and the highest of all. The influence of these bars will be to pre-

vent these deposits from escaping out to sea, even though portions of them shall be more or less moveable; they will move back and forth and will not go out to sea. I do not wish to imply that all of this deposit would be movable, a large proportion, the greater part of the mineral deposits would be thoroughly stable; once they reached the bottom they would stay there. But with that mineral deposit, there would be some organic deposit and that would be of lighter density and would tend to make certain portions of that material partially flocculent and movable so as to be moved by currents, at least until the organic matter had become separated from it by decomposition, leaving the mineral on the bottom. Now, observations in the bottom of the harbor show that this movement takes place, but they also show as indicated by the government dredgings preparatory to the cutting of Ambrose Channel, that those deposits never cross the bar; they are caught by the inner surface of the bar and are prevented from passing out. Now the tidal velocity over the bar is less than it is in any of these other sections. Therefore if the slope of the tidal bar is sufficient to prevent those, then the other bars will tend to prevent them, because they are not so strongly affected by tidal movements. The result will be that a discharge of mineral matter will go pretty rapidly to the bottom, not at one spot, but it will be deposited, and not

4239 very far removed from the individual outlets; the discharge of organic matter on the bottom will scatter somewhat more, but that in no case will even the most movable portions escape out to sea. The results therefore will be that they will tend to accumulate in the harbor; the mineral matters will never be decomposed, they will be constantly accumulating. The organic matters will be subject to decomposition and they will remain there until the different constituents have become decomposed. Now, there are certain constituents of sewage which are very rapidly decomposed, and there are certain other constituents which are very slowly decomposed. I am referring now to mineral deposits, and there are certain other deposits which occupy all the ranges between those two extremes, such material as cellulose and material such as hair and leather, and most fibrous materials, are among the — of those contained in sewage to be decomposed. Such material as animal flesh is most rapidly decomposed—vegetable tissue occupies a middle ground between the two; but there is sufficient volume on all sewage of these organic materials to produce an accumulation of undecomposed organic matter on the bottom. This is entirely in addition to the mineral matter on the bottom, which always accumulates and never suffers any decomposition whatever. My conclusion, therefore, is that, given the same discharge into New York Bay as predicted by General Robert for Newark Bay, that the difference will be that the accumulation will occur in more extended areas, but of lesser depths, but that in no case will the material escape out to sea.

Q. Directing your attention again, Professor Landreth, to Complainants' Exhibit No. 135, I ask if that exhibit discloses the area to be covered by the multiple outlets, and also gives the depth below

the surface of the water at which those multiple outlets will be erected, and as to whether or not in your opinion, the area and the depth below the surface of the water will in itself be an obstruction to navigation, and impair the use of the Main Ship Channel for shipping interests, docking in the City of New York.

Mr. Riker: Same objection and the further objection that
4240 the instrument speaks for itself; and the further objection that it is entirely in the jurisdiction of the United States Government.

The Commissioner: Note the objection of Counsel for the Defendants.

A. In my opinion there will be a dangerous influence and a menace to navigation even without the effect of the accumulation of deposits. The water at the point of discharge has a depth of about 40 feet. It has an area as given by the dimensions in the specifications of approximately $3\frac{1}{2}$ acres. We are already needing the drafts of upwards of 30 feet. In fact depths between 35 and 40 feet are imminent and we are likely to have them very soon. Those are not exceptional amounts in depth of draft; they are not spasmodic changes of draft, but they represent progressive changes in the draft of vessels, which have been going on for nearly a hundred years. They have been climbing up in size and not only in length but breadth of beam, and necessarily in draft, because the most economical form of ship has a certain relation between the length, the beam and the draft, and as the length and beam increases, the draft also increases, everything tends towards larger and larger units. That is true not only of water communication but of rail communication. Economy rests in moving large units and that is just as pronounced in water units in the hulls of ships as in trains. It has been going on and there is no reason to suppose it is going to stop now. We have already reached a draft of from 35 to 40 feet in depth; it is only in my opinion a matter of a few years before we shall reach a draft of upwards of 40 feet and even if we have a full available depth of 40 feet, it is only a matter of a short time before the outlets of this present sewer as now planned and as now approved by the War Department will be not only a menace, but a bar to navigation across that area, $3\frac{1}{2}$ acres in extent, right in the Ship Channel of the harbor, the only part of the channel that can be occupied by deep ships. The profile shown in

Exhibit No. 205, the Complainants' exhibit, shows that there
4241 is not a foot of territory on the west of that point anywhere to the Bayonne shore line where a draft of as much as 15 feet at that point can be found. There is only a narrow channel where 40 feet can be obtained, and to limit the usability of that channel by this construction would, in my opinion, be not only a menace, but an absolute bar to navigation for that portion. The draft of vessels as indicated by their registry is not the only dimension which is important to consider in the feasibility of harbor channels. The drafts are always recorded when the ship is in dock lying quietly; they are measured then and are recorded then not only the length of the load line, but the beam and the draft are recorded

when the ship is lying in the dock quiescent; but when the ship is over this disposal area, it will not be standing still, it will be moving and it will be moving at a pretty decent speed and it is a well established fact in navigation that when a ship moves in a channel which is at all restricted in either depth or width, that the motion of the ship causes a settling of the ship into the water called "squatting," and that the amount of that "squatting" in the water lowers the vessel. This, from well known and well understood causes comes from the fact that as the ship moves through the water the water must move past the ship; if it moves past the ship in a restricted channel, it must move at a considerable velocity, as it moves with velocity its energy is changed from pressure into motion and it is therefore no longer able to bear the ship as strongly upward as it was when it is standing quiet. Consequently the ship settles. The amount of that "squatting" is a function of the velocity of the water passing under the ship and that in turn is a function of the speed of the ship and the depth remaining, between the bottom of the ship and the bottom of the harbor; if that is narrow; the water will rush rapidly and the squatting will be greater, but it does not occur to any appreciable extent in the deep sea, at least not to so great an extent as it occurs in narrow channels. That fact is

so well established that in the design of Canal prisms, as in 4242 the enlargement of the Erie Canal and in the construction of the Barge Canal, that factor was a strong element in the determination of the depth to be provided. Now, this squatting is liable to amount to several feet, depending on the remaining depth between the bottom of the vessel and the bottom of the harbor. It may be two, three or perhaps even four feet. Therefore the bottom of the keel for a vessel drawing 36 feet would not be 36 feet below the surface of the water, but 36 feet plus the depth of its squatting, so that that depth must be taken just as arbitrarily and just as rigidly into account as the depth of the keel itself when the ship is lying in the dock, and must be added to that depth.

Q. Assuming a ship like the "Imperator" which left for Europe yesterday drew 38½ feet of water at the dock, how many more feet would you add as necessary for the squatting that you have described?

Mr. Riker: Counsel for the Defendants asks Counsel for the Complainants to indicate to what testimony this question is directed as rebuttal.

Dr. O'Sullivan: This testimony is directed in rebuttal to that portion of Mr. Johnson's testimony in which he took Complainants' Exhibit No. 135 and on page 30, testified from that exhibit that there would be no impairment to the navigability of the New York Upper Bay.

Mr. Riker: Well, the attention of the witness is then directed to the specific testimony, as the recollection of counsel is that there is no such testimony by Mr. Johnson, and the question is therefore objected to on the ground that it is not rebuttal, but it is an attempt to introduce into this case, a new issue not made by the pleadings, and is also an attempt to introduce an issue which involves the sovereign jurisdiction of the United States Government.

Mr. O'Sullivan: The question is pressed by Complainants' Counsel for the reason that the obstruction to navigation in the Main Ship Channel in New York Upper Bay would impair the property
4243 rights and the property interests of New York City and of New York State.

Mr. Riker: Counsel for the defense rejoins to that suggestion as to the reason for pressing the question, that if the United States Government sees fit to close up the whole of the channel, it is within its sovereign power to do so, and that therefore this question is not only incompetent and irrelevant, but it is impertinent.

Mr. O'Sullivan: Counsel for Complainants in reply to that will state affirmatively that the function of the Secretary of War therein is to preserve the navigability of navigable channels and bodies of water and not to exclude shipping from their use,—not to close them up to navigation.

Mr. Riker: Counsel for the defense again rejoins that the permit of the Secretary of War is already in evidence in this case and permits the erection of this particular structure in the harbor of New York, upon the terms that are indicated in the stipulation, and that his judgment is supreme.

Mr. O'Sullivan: In re-ly to that comment of Counsel for the defense, Counsel for Complainants answers that the second condition in that permit shows the revokability of the permit and that the moment that the structure to be erected under the permit becomes an obstruction to navigation, that the Secretary of War has reserved to himself the right to revoke the permit.

Mr. Riker: Counsel again rejoins that that answers the whole objection and enforces the proposition, that this testimony is entirely irrelevant, as the United States Government, as the supreme power, has the power and the right to change the location of these outlets or to remove them if it sees fit.

Mr. O'Sullivan: Complainants' Counsel still presses this question for the reason that it shows that now the property interests and the property rights of the State of New York and of the City of
4244 New York are threatened by this structure about to be erected under this permit.

Mr. Riker: Counsel for the defense again rejoins that those objections should be presented to the Secretary of War and that they are not questions for this Court to deal with.

Mr. O'Sullivan: And in re-ly to that Counsel for Complainants wishes to assure Counsel for Defendants that they have already been submitted to the Secretary of War and are now under consideration by that official.

Mr. Riker: Then Counsel for the defense objects that it becomes still more evident that this question is not only irrelevant but impertinent.

(The stenographer read the question as follows):

Q. "Assuming a ship like the "Imperator" which left for Europe yesterday drew 38½ feet of water at the dock, how many more feet would you add as necessary for the "squatting" that you have described?"

A. In answer I wish to say that I have not made a close study of the form of the lines of the hull of the *Imperator* and neither do I know the speed at which she actually would pass out of the harbor, both of which elements are essential; but assuming the general form of hulls followed by the company by which this ship is owned, and assuming a speed of 10 knots per hour, I should say that the "squatting" would amount at least to a foot and a half or two feet, but I don't believe it proper to allow a construction to be erected in the harbor which shall be at the same distance below the surface of the water as the bottom of the hull is below the surface of the water. I do not believe in other words, you can afford to rub the keel on the obstruction just stated and that a leeway between the keel, even when the ship is under the influence of "squatting," and the bottom of the harbor is also a well recognized necessity in harbor construction and in canal construction and in lock construction, and in dock construction, and the margin of a foot is the least that is ever considered as coming between these two, even ignoring the question of the increased motive power necessary to move the ship under "squatting," due to 4245 the fact that the ship is all the time climbing up a steep grade, all the time propelling itself out of a depression up the side of a slope, which very materially increases the motive power, and thoroughly apart from that and purely on the basis of safety against accident from contact between the ship and the bottom a margin of at least one foot is always considered essential in the design of locks and docks and basins and the like, and still more in harbors where the conditions are not subject to as close predetermination, so that if the *Imperator* draws 38½ feet in the dock, I should now consider that such a construction if built today would be an obstruction to navigation to that ship.

Mr. O'Sullivan: That is all.

Cross-examination by Mr. Riker:

Q. Professor, what is the depth of the water in the Ambrose Channel at mean low tide?

A. It is approximately 40 feet.

Q. The ships pass through the Ambrose Channel, do they?

A. I think she did.

Q. Is that the main entrance into New York Harbor, into New York Bay at the present time?

A. It is the most direct; it is not the only one.

Q. Is it the best one?

A. It is the best one for ships whose drafts permit them to come that way, because it represents a material saving in distance.

Q. Where did you understand these outlets to be located with reference to the bottom of the Bay?

A. I understand they are located at or slightly above the actual surface of the bottom of the bay where they are placed.

Q. Why do you say that?

A. I say that because I do not wish to be unfair to the defendants by assuming that they project up into the Bay; I have not assumed that they do.

Q. Well, do you know anything about it; I am not asking you what you assume, I am asking you what you know about it?

A. I know that they were either to be made at the surface
4246 of the Bay or project up into the water way; they cannot go below the surface of the bay.

Q. They will either be on the surface or project up; now which are they to be?

A. I have assumed that they would be on the surface.

Q. Then you are objecting to the surface of the floor of the Bay, aren't you?

A. Yes.

Q. You don't think that is deep enough?

A. I think that can readily be dredged deep enough, if it is not.

Q. Can the outlets of the sewer be readily put down to the increased depth?

A. No, sir.

Q. Why not?

A. If they are built, they cannot be lowered.

Q. Will you tell us why they cannot be lowered after they are built?

A. Not without reconstruction, not without the expenditure of large amounts of money, and not without interrupting the discharge.

Q. Well, do you think the bottom of the Bay can be deepened without expenditures of large sums of money?

A. Comparatively, yes.

Q. I am not speaking comparatively; I am asking you whether the dredging of the bottom of the harbor requires the expenditure of a large amount of money in your judgment?

A. The relative cost of excavating the harbor of $3\frac{1}{2}$ acres would be very slight, insignificant almost, compared with the expense of lowering the structure for the discharge of the sewage.

Q. You don't mean to be understood that you think it is not a possible thing to lower these outlets if the depth is increased?

A. It is not an impossible thing; it is not impossible to discharge this effluent into the Passaic River for that matter.

Q. I did not ask you that question; you need not volunteer anything. Answer the questions without interpolating your own suggestions and I will be obliged to you.

A. I will withdraw that part of my answer, Mr. Riker.

Q. How deep is the Ship Canal at the point of discharge, the greatest depth?

A. The Ship Canal?

4247 Q. Yes.

A. What canal have you reference to?

Q. The Ship Channel, I mean, at Robbins Reef?

A. Well, at the point of discharge it is 40 feet.

Q. Well, immediately outside of the point of discharge, how deep was it?

A. By "outside" do you mean out towards sea?

Q. Out towards the center of the Ship Channel?

A. It reaches a depth of about 65 feet.

Q. How wide is it with that depth?

A. It is very narrow indeed.

Q. How wide?

A. Well, just one foot so to speak; it runs down to that point there. If you take a point above the bottom, I can give you the width.

Q. Well take it at 50 feet in depth; how wide is the Ship Channel?

A. At a depth of 50 feet the Channel is about 2,000 feet wide.

Q. And this area of the outlets of the Passaic Valley sewer is on the side wall of the Channel, isn't it?

A. Well, there is no wall there; it is on the side slope.

Q. On the side slope?

A. Yes, sir.

Q. Is it your conscientious belief, Professor Landreth, that the insertion of these outlets on the surface of the slope of the Ship Channel at a depth of 50 feet for a width of 2,000 feet is going to interfere with the navigation of New York Bay at that point?

A. It is.

Q. How?

A. By the fact that the large volume of tonnage coming in and out of the harbor makes it impracticable for each ship to select its own lane or line, and to adhere to that; it has to have a certain amount of leeway laterally across the channel, and it would mean if this obstruction is allowed to continue, allowed to be produced there, that ships of this draft would have to avoid that, would have to be kept clear of that area; would have to have a system of buoys there and depth markers for ships of different drafts. It would be greatly confusing and they would in themselves cause interference with navigation.

Q. How much additional width do you think there would be in the ship channel if these outlets are not placed there of a 4248 depth of 40 feet?

A. I can give you the width.

Q. Do you understand my question to be how much in width the location of these outlets as proposed are going to decrease in your judgment, the available steerage rooms of ships in the channel?

A. Why, with the attendant works, it would diminish the width by several hundred feet.

Q. What do you mean by the attendant works?

A. I mean the construction supplementary to the discharge of the sewage through the outlets.

Q. What are they?

A. In the first place, the main tunnel itself; in the second place, any gate house construction, and outlet or shaft house construction that may be built there; and in the third place, the very outlets themselves and the area which they cover. The plans offered are not sufficiently in detail to show the width and the detail of those supplementary portions, but I am taking the area as $3\frac{1}{2}$ acres and taking the dimensions of that dispersion field as indicated, and then taking the necessary inevitable supplementary works when I say there will be several hundred feet additional width which would be impaired, and as far as the channel goes that would extend all the way to the west shore.

Q. Do you think the tunnel is going to interfere with navigation?

A. Not unless it is kept up to somewhere near the depth at which the outlets are given.

Q. Well, the tunnel in itself how is that going to interfere with navigation?

A. The depth of the tunnel in itself and its covering will interfere with navigation, just in proportion with the depth of the top of it below mean low tide.

Q. You understand that a tunnel is something that is covered over with artificial means?

A. Well, it depends on how you construct and operate it; besides if it has a gate, or has a tube tunnel, it must have a shaft; the shaft must have protecting works around it.

Q. I am asking you about a tunnel, I wish you would not get away from that. I am asking you about a tunnel and I want to know how you think a tunnel under New York Bay is going 4249 to impede navigation?

A. A tunnel under New York Bay would impede navigation if the future needs or present needs demand dredging, which would be interfered with by that tunnel, and in no other way except so far as the supplemental works of shaft house and permanent gate house may be concerned.

Q. So that as to the present conditions, you don't mean to be understood as saying that a tunnel will interfere with navigation, do you, in itself?

A. A tunnel in itself will not interfere with navigation as the harbor bottom is today, but I have added supplemental works which are tied up with the tunnel and cannot be separated from it.

Q. I want to know what supplemental works you are testifying to as interfering with navigation?

A. I am testifying to the two supplemental features that go along with the tunnel, namely, the shaft house, one or more, which must be built there, and the construction and filling around it, and so on; secondly with the rendering impossible of the dredging of the harbor, lower than the top of the tunnel, those two are two features which are inseparable from the tunnel itself.

Q. Now, where is the shaft house to be located, do you know?

A. I don't know; there must be a shaft house there.

Q. Do you think that is going to be located in the Ship Channel?

A. I cannot say where that will be located.

Q. Well, do you think it is going to be?

A. I think it very likely will.

Q. In the Ship Channel?

A. At or near the point of entry of the sewage into the discharge mains.

Q. Now, how far is that from the Channel?

A. That is part of the Channel.

Q. It is in the Ship Channel in your judgment?

A. Yes.

Q. That the shaft house is to be located?

A. Yes.

Q. Do you think they will build a shaft house in a depth of water of 44 feet?

A. Your question did not ask that; your question asked me where the point of beginning of the dispersion area was, and that 4250 is in the Ship Channel.

Q. I asked you where you thought the shaft house was to be located; you don't hear very well, Professor, I am afraid?

A. Yes, I hear first rate.

Q. That is the question, and I refer you to the record; I want to know where the shaft house will be located?

A. I told you I did not know, but I thought it would be near the point where the sewage leaves the tunnel.

Q. Now, I ask you whether you think the shaft house will be located in the channel?

A. I think the shaft house may be located there.

Q. Near the edge of the channel but not necessarily in the deepest part of the channel, of course; you don't know anything about it as a matter of fact, do you?

A. I don't know anything about what you people actually will do, no.

Q. Now, you said in your opinion the discharge from the sewer outlets will be vertical, didn't you?

A. Yes.

Q. You told others that that was your opinion?

A. I said vertical or horizontal.

Q. Well, didn't you say that you thought it would be vertical?

A. If you read the answer I think that you will find that I said vertical or horizontal.

Q. Well, what do you think it will be?

A. I think it will be vertical or horizontal as I answered before.

Q. Why do you think it will be vertical?

A. From some indications which I have had that that is the nature of the outlet; I have seen two outlets proposed by your people, one to consist of a pair of horizontal outlets; in other words, a vertical T capped with a pair of horizontal outlets, and another style of outlets, a vertical nozzle, ostensibly an inverted conical nozzle, giving a so-called spiral movement. I cannot say which of those two outlets you people are going to adopt, and I don't attempt to say, because I do not know. I do know you would not point them downward, as in Johnson's experiments; I know you have too much sense for that.

4251 Q. I am not asking you for that or the sense of it; I want to know your reason for saying that you think the outlets of the discharge may be vertical, and you have given it, and I now direct your attention to the stipulation which is Complainants' Exhibit No. 135, from which I will read: (Reading) On each of these vertical T's shall be placed outlets arranged to discharge horizontally across the tidal current?"

A. Yes.

Q. Now, having that before you, do you mean to say that you think the discharge may be vertical?

A. I have also before the fact——

Q. Will you answer the question?

A. Yes, I will answer it, but I will have to answer it in my own way or not at all.

Q. Then don't answer it all unless directly?

A. That does not lead me to conclude that the discharge will be horizontal.

Q. You make a distinction between the outlets and the discharge, do you?

A. No. I will go farther in saying that I don't conclude that the outlets will be horizontal in spite of the fact that that plan, which you are permitted to depart from, says so.

Q. Where are we permitted to depart from it except——

A. In the clause following; in the article or paragraph following that, you are permitted to follow that plan or other lawful plans.

Q. That is your interpretation of it, is it?

A. Yes, sir, Mr. Riker.

Q. Is it not your understanding that the plans must be approved by the Secretary of War?

A. I assume they must, yes, sir.

Q. And you think then that this stipulation which has been entered into by the State of New Jersey with the United States of America does not indicate any fixed plan at all; is that your understanding of it?

A. No.

Q. Well, then, do you understand that it provides for a horizontal discharge?

A. No.

Q. You do not?

A. No.

Q. It says so, doesn't it?

A. No.

Q. I read it again; (Reading) "On each of these vertical
4252 T's shall be placed outlets arranged to discharge horizontally across the tidal current." Does that mean what it says or doesn't it?

A. I have read it several times.

Q. What do you understand that means?

A. I cannot answer it except in my own way.

Q. Answer it in your own way; what do those words mean?

A. Not only your people have planned this one, but also a different one in which the discharge is vertical and that the agreement with the Government permits you to depart from either one of these, so long as it is not unlawful; and under that I believe that you will discharge vertically upward; you may discharge downward, but I don't think you will.

Q. I ask you what you understand the words I have read to mean; whether they mean horizontal discharge or not?

A. Those words there clearly mean horizontal discharge, but you are not bound to follow those.

Q. And you extend that opinion to the whole of this policy do

you, that we are at liberty to change them as we see fit; is that your understanding of the stipulation?

A. No, oh, no.

Q. Then why do you say we are at liberty to change this part of the stipulation?

A. You are at liberty to change this within lawful limits.

Q. To reach certain definite results?

A. Yes.

Q. And you think we can reach those certain definite results if we discharge the sewage vertically?

A. I do not.

Q. Then you think we have a right to change the direction of the discharge, do you?

A. I do.

Q. Have you made any dye experiments, color experiments, in the harbor of New York?

A. No, sir.

Q. Where did you make your experiments?

A. At Union College Engineering Laboratory, Schenectady.

Q. You think that those conditions are parallel to the conditions in New York Bay?

A. Not entirely, but the things which I studied are just 4253 the same in New York Bay as they are in Schenectady or Toronto.

Q. Why didn't you make your experiments as Mr. Johnson did, in New York Bay?

A. Because it was not possible to make the observations of the same degree of refinement and to govern conditions as closely as it was in the laboratory where we can control everything except the thing which we wish to study; as I tried to make clear on my direct examination, I was trying to study the single element of the effect of velocity on a jet, whether a high velocity or a low velocity, and I studied that and kept everything else constant. Then having finished that, I desired to study the effect of direction of discharge and keep everything else constant; it would not have been possible to do that in New York Harbor, and it was possible in the laboratory in large sized experiments, and since the application of these laws are fixed and immutable and apply just as well in New York Harbor as in the engineering laboratory at Union College, I am safe in the conclusion that when I discovered that the effect of velocity has a certain result in the laboratory it will have the same effect in New York Harbor so far as the qualitative results go; I do not claim the same as to the quantitative results.

Q. You do not doubt the experiments conducted by Mr. Johnson were conducted as he described?

A. I do not doubt that at all; I have assumed that they were.

Q. And the results were as he described them?

A. I assumed so, exactly as he described them.

Q. Do you assume so?

A. I assume so.

Q. Do your own laboratory experiments coincide with the results that he attained from his experiments as he described them?

A. While I do not differ with Mr. Johnson as to the methods of his procedure, I do differ from his conclusions which he drew from them.

Q. I did not ask you for a conclusion; I am asking you for the results?

A. My results? Mr. Johnson did not testify to results; he testified to conclusions.

4254 Q. He didn't testify to results?

A. Unless you take the appearance or non-appearance of liquid as a result, and in that mine agreed with his substantially.

Q. Isn't that a result?

A. Well, if you wish to call that a result.

Q. Don't you call it a result?

A. I will call it a result to satisfy you, and in that they agreed substantially with Mr. Johnson.

Q. At what depth did Mr. Johnson discharge the colored water?

A. 10, 20, 30 and 40 feet in depth.

Q. Does it make any difference in your judgment at what depth the colored water is discharged as to its appearance on the surface?

A. Certainly.

Q. At what rate of vertical discharge at the rate Mr. Johnson testified he discharged the colored water would the result be equivalent in your judgment to the same discharge in quantity and horizontally at a depth of 4 feet?

A. I don't understand the question.

Mr. Riker: Read the question.

The stenographer thereupon read the question.

The Witness: Well, I still must admit I cannot understand the question, when you ask detailed conclusions from it.

Q. You don't understand the question?

A. I do not.

Q. I still press the question as perfectly clear?

Mr. O'Sullivan: I now object to the question on the ground of ambiguity; it is clearly a conflict in terms.

Mr. Riker: I press the question as perfectly clear and understandable; if this witness cannot answer it, it is because he cannot.

The Witness: I am sincere in my wish to answer it; if you will try to alter the wording, I may answer it.

Q. It is so simple in its terms I do not believe I can make it any simpler?

A. Then I am so stupid I cannot comprehend it.

4255 Q. Do you understand that the discharge from the Passaic Valley Sewerage Commissioners' sewer is correctly described in Complainants' Exhibit No. 135?

A. I assume that one possible plan of discharge is described accurately there, yes, sir.

Q. But not the results to be obtained in New York Bay from the discharge of the effluent?

A. I do not believe the results will be obtained, no, sir.

Q. And you do not believe that they propose to produce those results in New York Bay?

A. I do not understand what is meant by the word "propose"; I have no question as to their sincerity in desiring to obtain them.

Q. Well, do you doubt that they have agreed to obtain them?

A. No.

Q. Do you doubt that they intend to obtain them?

A. No.

Q. But you doubt that they will carry their intention into effect?

A. I doubt their ability to obtain the results that are indicated and to make possible the determination as to whether they have obtained them or not.

Q. You mean that the results that are guaranteed are impossible of determining as to whether or not they are produced?

A. I mean the form in which the results are stipulated are ambiguous.

Q. They are equally ambiguous in connection with the Bronx Valley Sewer?

A. So far as the two agreements are parallel, they are.

Q. Don't you know that they are identical so far as the results are concerned?

A. They are for a certain term of years.

Q. Well, the results as described, are they or are they not identical?

A. They are not identical in another respect, also that whereas in the Passaic Valley Sewer agreement with the Government there is no provision for means of ascertainment other than is carried by the words themselves, left to ordinary determination; in the Bronx Valley agreement a specific means is provided by which these compliances shall be ascertained and the results interpreted, also in the Bronx Valley agreement, the agreement which is imported from the 4256 Passaic Valley is limited to a certain term of years, at the termination of which time the entire agreement may be altered and the terms changed.

Q. I ask you again whether the guaranteed results as contained in the Bronx Valley stipulation are not identical with the guaranteed results contained in the stipulation which is Complainants' Exhibit No. 135?

A. With the few important exceptions that I have just mentioned, they are.

Q. Do you think that the results in the one case can be determined, and cannot in the other?

A. Yes.

Q. Which ones can be determined in the one case, but cannot be in the other?

A. In the Bronx Valley case a very definite system of verification is provided for in which discretion is left to the arbitrators or Board of Inquiry to ascertain substantial compliance, while no provision for interpretation is made in your agreement.

Q. What is that provision that you refer to?

A. It is the provision by which either party may invoke a Board of Inquiry—I have forgotten just the name employed for it—

to determine the question of the compliance with the agreement and to determine what needed modifications or changes of plan may be essential or necessary. Even if the first one had not been included, the fact that the power of providing for modifications in the agreement is there, would make it possible to cure the defect even if this Board did not have the power of interpretation.

Q. You seem to misunderstand my questions frequently; our minds do not work the same. The definite provision is what I want you to say, that you think is contained in the Bronx Valley stipulation and not in this; the definite standard provision that is so ascertainable.

A. I had it in mind and answered it as far as I am able to by memory and you asked for an explicit understanding and I——

Q. I was trying to get you to — what I supposed you had in mind, the 10 per cent. reduction in putrescibility; is there
4257 any other definite standard than this?

A. I am not referring to that at all.

Q. You are not referring to that at all?

A. I am referring to two other points of difference.

Q. What are the two other points of difference as to the results guaranteed?

A. The two other points of difference are those which I have mentioned twice.

Q. Just mention them again, briefly, if you can?

A. The first is that there is a term of years over which this shall remain in force; the second is that there is a provision for a Board of Inquiry—I am in doubt as to the name given to that—that is one of the things I am trying to verify,—by which recommendations for changes of those agreements may be provided.

Q. I am asking you, however, or trying to ask you, in regard to guaranteed results; you don't call those results, do you? What I want to know is what guaranteed results are in the Bronx Valley stipulation more definite and more easily ascertained than in the Passaic Valley stipulation; I am not asking you for provisions for changes at all, I am asking you for the instrument as it stands with reference to the guaranteed results, which are more easily ascertained in the Bronx Valley than in the Passaic Valley stipulation?

A. There is this additional, which is a third point of difference——

Q. I did not ask you as to the point of difference; confine yourself to what I ask you?

A. The third point relates to just what you are asking about, the greater precision with which the results are to be stated.

Q. Now, what is that?

A. This agreement recites as follows: "The Bronx Valley Sewer Commissioners at once will begin the installation of the plant for the special purification of the effluent of the Bronx Valley Sewer system, by screening and sedimentation with an efficiency sufficient to remove and which shall at all times remove from said effluent enough of its putrescible contents to purify the same to
4258 the extent of 10 per cent. upon an absolute putrescibility scale."

Q. Now, that you think is more definite, do you?

A. Yes.

Q. Do you agree with those witnesses who have testified that the works as described specifically in the Passaic Valley stipulation will reduce at least 10 per cent. the putrescible matter in the sewage?

A. I think I do not.

Q. You think you do not?

A. Yes.

Q. Well, have you calculated how much they will reduce the putrescible matter?

A. I have not.

Q. Then why do you guess about it at all, if you do not know?

A. I estimate and believe that they will not do so, because of the conditions under which the putrescible material is sought to be removed in the Passaic Valley Treatment Works; I don't believe that they will remove the amount indicated as required to be removed in the Bronx Valley stipulations.

Q. If witnesses went on one after another for the Complainants in this case, and testified upon examination and cross examination that the works as described will remove at least 10 per cent. of the putrescible matter, you do not agree with them, is that it?

A. If all witnesses were unanimous in saying that it would, I should begin to doubt my belief and opinion, if they were reputable and authoritative witnesses.

Q. As to all other features of the two stipulations, do you think that the Bronx Valley is more specific than the Passaic Valley, or the contrary?

A. Insofar as relates to the stipulations which are common to the two, there is no difference; the one copies the words of the other virtually.

Q. Well, now those things, that are in common and copied one from the other, do you think that in the one case they would be more easily ascertained than in the other?

A. I do.

Q. Why?

A. For the very reason that I have stated once before, that 4259 during the first period of years provided for, the Bronx

Valley has this additional standard by which to test the accomplishment of the results and at the end of that period the Bronx Valley has the power to provide for an entire alteration and revision of that set of specifications.

Q. Then you think that the removal of 10 per cent. of putrescible matter on an absolute putrescibility scale will result in the case of the Bronx Valley Sewer in the results which are guaranteed in that stipulation do you?

A. I have not stated that at all, nor any approach to it, and there is no opportunity for doing that, because I have not seen the plans by which that 10 per cent. is proposed to be reduced.

Q. You know that the State of New York and the Bronx Valley Commissioners have agreed to produce the same guaranteed results that the State of New Jersey and the Passaic Valley Sewerage Commissioners have agreed to produce, don't you?

A. I do, and if you wish the answer in this form, I will say I believe it can be done and I believe the Bronx Valley people will do it.

Q. I ask you whether or not you believe the removal of 10 per cent. of putrescible matter from the sewage of the Bronx Valley will produce the results that are guaranteed in the stipulation?

A. Well, I am in doubt about that question.

Q. Well, do you think the State of New York and the Bronx Valley sewerage Commissioners are sincere in their undertaking with the United States Government?

Mr. O'Sullivan: Objected to.

The Commissioner: Note the objection.

A. I do.

Q. Do you think they can do this and accomplish these results and the Passaic Valley Sewerage Commissioners cannot, do you?

A. I do not think they can legally do it any more rightfully than the Bronx Valley, but with the difference that they will be held up at the end of their time if they are not doing it, and there is no provision for holding up the Passaic Valley parties 4260 other than an absolute revocation of the permit after the plants are once in operation. In fact, as I have said before, the underlying obstacle and objection there is the non-determinability as to whether they are complying or accomplishing the results or not.

Q. You are criticizing the form of the stipulation that has been entered into through the Attorney General of the United States, are you not; that is your present criticism, is it not?

A. I do not think I would put it quite in that form, no, sir.

Q. Well, isn't that the result of it; do you think the stipulation of the Passaic Valley Sewerage Commissioners should have contained same provision of that kind that is in the Bronx Valley Sewerage Commissioners' stipulation?

A. I do not hesitate to say that I think the agreement should have provided more determinable means for ascertaining the compliance than it contains at the present time. Now, I don't know who is at fault for that whether it was the Jersey authorities or the United States authorities; I do not attempt to criticize or even try to locate the cause.

Q. Now, Professor Landreth, taking the assumption that the removal of the 10 per cent. of the putrescible matter from the Bronx Valley Sewers does not accomplish the guaranteed results in the stipulation of the Bronx Valley Sewerage Commissioners, do you understand that they intend to make an effluent which will produce those results?

A. If the compliance with the 10 per cent. reduction does not accomplish the results, there will be no way to determine that fact in legal form, in a way to constitute proof, but that is saved and the harm from that is rendered impossible, by the fact that at the end of a certain period, that agreement no longer is in force and may be modified, consequently the harm would be of shorter duration; but if the 10 per cent compliance is accomplished, there is no way to ascertain whether the others are accomplished or not in my

belief, any more than there is in the New Jersey or Passaic
4261 Valley agreement, for all time, without any specific 10 per
cent. standard.

Q. You think a nuisance can be produced without your being
able to ascertain or prove it?

A. I think before you prove a nuisance on a man, you have got
to prove he is the cause of it; you cannot indict him if his neighbors
are likely to have been the real cause. You have got to prove it
against a man himself and prove him to be the cause of it.

Q. That is so, but I ask you whether you think a nuisance can be
produced without it being susceptible of ascertainment and proof as
a nuisance?

A. Oh, no, I assume that it is possible, but the fact that a nuisance
exists does not complete the indictment; it is necessary to determine
who is the agent of that nuisance. That is what New Jersey has
agreed not to be—not to be the cause of the nuisance; it does not
agree to protect New York Harbor against its own pollution.

Q. The Bronx Valley Commissioners have undertaken the same
thing with regard to the Bronx Valley sewer have they not?

A. Yes.

Q. And you think if the removal of that 10 per cent. does not
in fact produce an effluent that is guaranteed that not being sus-
ceptible of proof, although it is an actual fact that the New York
authorities will take advantage of that and not produce the results
guaranteed?

A. I do not mean to say that, that the document itself as a con-
tract would not be enforceable unless you show that after the 10 per
cent. has been produced and if a nuisance were being produced, you
could not determine whether it was produced by the Bronx Valley
Sewer Main, by Manhattan, Jersey—or any of the other towns.

Q. In other words in your opinion, the whole part of the stipu-
lation which deals with the guaranteed results are practically flim-
flam and not intended to have any effect at all, or to be paid any at-
tention to?

A. I think it is a good deal less flim-flam than the document or
form of agreement between the United States and the State of
New Jersey.

Q. Now, I am directing your attention specifically to the
4262 provision with regard to the guaranteed results; I ask you in
your opinion in regard to the Bronx Valley Sewer agree-
ment with the United States Government, whether this part of the
agreement is practically without meaning?

A. No.

Q. Well, what do they mean; what do the words mean, do they
mean what they say?

A. They mean that when the 10 per cent. reduction has been
accomplished, that if they still afford a nuisance, that there is no
way to ascertain it any more than there is in the New Jersey agree-
ment.

Q. That is what the agreement means?

A. Yes, sir.

Q. It does not mean that if the 10 per cent. reduction does not

result in preventing a nuisance from the discharge that the Bronx Valley Sewerage Commissioners will add another means of purification, which will result in the guaranteed results?

A. That provision there is the same as it is in the Passaic Valley agreement.

Q. Will you answer my question?

A. I assume, of course, that if it can be proven to their satisfaction that the 10 per cent. having been complied with and that a nuisance still exists, I assume that they will go ahead and construct other additional and modified works to accomplish that; but I am saying that it is in my opinion impossible to determine that fact, and that therefore that relief is for the time being out of our reach and we must put up with that during the remainder of the term.

Q. Well, now, I ask you whether you think in your opinion, that at the point of discharge in the Passaic Valley Sewer, there will be sleek fields?

A. I do.

Q. You believe that?

A. I do.

Q. That there will be odors?

A. Yes.

Q. There will be floating particles of matter?

A. I don't think the odors will be serious, but I think there will be odors.

Q. Is there any difficulty in identifying the sleek fields with the discharge from the Passaic Valley Sewer as it exists?

A. Less difficulty in that than in others, but still more difficulty there.

4263 Q. Why?

A. There are other Brooklyn outlets which are not very far removed from that.

Q. How far removed?

A. Oh, I should have to scale off a map; I should say a mile or so.

Q. Any sleek fields extend out to Robbins Reef from those sewers at the present time?

A. I never have myself seen one.

Q. Well, you have been there a good many times, haven't you?

A. Yes.

Q. Any sleek fields from any sewers that you know of that extend to Robbins Reef at the present time?

A. I have seen sleek fields that extend opposite to that point; I don't think they have gone as far west as that point—any that I have seen.

Q. How near have you seen them determinable as a sleek field; how near to the point of proposed discharge?

A. I would not want to be explicit enough to answer that although I should like to; I should say that I have seen them certainly within half a mile.

Q. Now, if there is no sleek field developed over the point of discharge into the Passaic Valley sewer, do you think there is any dif-

difficulty of identifying it to the satisfaction of a court and jury that this is coming from the Passaic Valley?

A. There would not be if no one had seen a sleek field within half a mile, but I am providing for the fact that people may have seen it frequently.

Q. Have you ever heard of any sleek fields extending to Robbins Reef?

A. I have never asked one about that specifically, never directed the attention of any one specifically to that.

Q. How often have you been over the point of discharge of the Passaic Valley Sewer?

A. You mean over it, in the near proximity, the line of the boats?

Q. Near enough to observe the water?

A. Oh, I could not say certainly; 50 times probably 100 times.

Q. Seen any sleek fields there extending that far?

A. I have never seen sleek fields, I am sure, within a half mile of there.

Q. Do you think there is any danger of New York discharging more sewage, so as to extend their sleek fields into New Jersey?

A. I do not.

Q. Well where would you anticipate there would be any conflict between the sleek field produced by the Passaic Valley Sewer and any other sewer?

A. I am anticipating simply the legal difficulty of producing legal proof that sleek fields come from the Passaic Valley sewer, and I am appreciating the fact that if any one else has seen sleek field there, caused by Brooklyn or produced there, before, that that would practically render it impossible of conclusive proof. That is the difficulty.

Q. You are taking a judicial attitude toward the quality of the proof, are you?

A. I am taking a common sense attitude.

Q. You are taking a common sense attitude are you, that where a sleek field never existed before, and has been produced immediately after the operation of a sewer discharge there, that that is not proof that a sleek field has come from the sewer?

A. You have incorrectly quoted my assumption.

Q. I have asked you to take that assumption.

A. Under that assumption it would be entirely proper to conclude that the sleek field was produced by the Passaic Valley, but that is not the condition I was supposing.

Q. What are the conditions you are supposing?

A. Conditions which I have stated were that I have not watched that field forever, have not seen it every day, and while I never have myself seen a sleek field within a certain distance, not more than half a mile away, I don't mean to conclude that therefore a sleek field never has and may not many times have reached over the point where the Passaic Valley Sewer proposes to discharge; I don't know what persons may be living today, who have seen that.

Q. Do you believe any such thing ever existed?

A. I don't know.

Q. I am asking your opinion; you are here as an expert witness, what is your opinion? Do you believe any such thing has ever existed?

4265 A. Taking the matter of probability, I do not believe the sleek field has ever, or at least as often, reached that point.

Q. Do you believe it has ever reached that point, as an expert?

A. I think it may have done so, yes, sir.

Q. That a visible sleek field has extended to the point of discharge within the State of New Jersey, caused by the sewage from New York?

A. I am saying it is possible.

Q. I am asking you whether you believe it ever existed?

A. My opinion is that it never has, but my opinion does not cover all possible proof.

Mr. Riker: That is all, Professor Landreth.

Redirect examination by Mr. O'Sullivan:

Q. Professor Landreth, directing your attention to the stipulation marked Complainants' Exhibit No. 135, I ask you what the date of the execution of that stipulation was?

A. April 14th, 1910.

Q. In Complainants' Exhibit No. 135 are the points of discharge described as being horizontal at these multiple outlets?

A. I think they are, yes, sir.

Q. Have you seen plans of the Passaic Valley Sewerage Commission by Mr. Harrison and Mr. Taylor, dated December 1910, in which the discharge points are vertical?

A. Yes, sir.

Q. Comparing the dates of this Complainants' Exhibit No. 135 with Complainants' Exhibit No. 177, which is the Bronx Valley Sewer stipulation, which is the more recent in point of time?

Mr. Riker: They speak for themselves; the question is objected to for the reason that the exhibits speak for themselves.

The Commissioner: Note the objection of Counsel for the Defendants.

A. The agreement with the Bronx Valley Sewer Commission is of more recent date.

Mr. O'Sullivan: I think that is all.

4266 Recross-examination by Mr. Riker:

Q. Do you know whether the designs which you have seen of Mr. Harrison and Mr. Taylor have ever been adopted by the Passaic Valley Sewerage Commissioners?

A. I have reason to believe that they have been, although I do not know.

Mr. Riker: That is all.

Mr. O'Sullivan: That is all.

Mr. O'Sullivan: The Complainants rest.
Adjourned sine die.